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BITUMINOUS STABILIZED BASE CONSTRUCTION IN MISSOURI

Traveling-Plant-Mix Method Employed on Seven-Mile Job Near Kirksville

By JOHN C. BLACK

Field Editor, Roads and Streets

AN innovation in Missouri was the "traveling-plant-mix" method of base construction employed on 6.952 mile of road between Kirksville and Novinger in the late summer and early fall of 1936. The base is a bitumen-stabilized type, 22 ft. wide, with a 4 in. thickness over the middle 18 ft., and a 2-ft. strip tapered to 7 in. thick at each edge. The crown ranges from 2 to 3 in.

The surface to be laid on such a base is determined by the traffic needs. In the present instance it is planned



All photos by the author.

Base Immediately After Finishing



A Windrow of Fresh Gravel

to use a "seal coat," or "armor coat," consisting of a prime application of 0.22 gal. per sq. yd. MC 1 or MC 2 liquid asphaltic material, to be followed with 0.35 gal. per sq. yd. RC 3 or RC 4, blotted with 35 lb. of pea gravel, and rolled until set. This work will be done in the spring of 1937.

loosened from the old surface and thoroughly broken up, while 10 yards is new gravel from a local pit.

Granular material meeting the requirements of Sec. 38-1E, Grade B, of Missouri Standard Specifications, is used. Payment for new aggregate is by weight. Moisture tests were made three times daily, and any water weight in excess of 2 per cent was deducted.

Preparation of Aggregates and Sub-Grade

The entire amount of new gravel (10 yd. per station) is dumped on one shoulder of the road and spread uniformly over the entire shoulder width (about 20 ft.). The old surface is then scarified to a depth of 2 or 3 in., two scarifiers in tandem—or in especially hard places a single scarifier—being used for the purpose. This is followed by harrowing with a disc to break up all large clods. Next, a cut is made 3 in. deep and 14 ft. wide through this loosened material to final subgrade, the 14 ft. being measured from the outer edge of the base construction. The excavated material is thrown onto the shoulder to be mixed with the fresh gravel. Tractor and blade graders are used in these operations.

The Traveling Mixer Plant as Seen from in Front. Note the two windrows—aggregate at left, and finished product at right.



Location and Aggregates

The entire improvement is located on an old gravel road, about ½ mile of which is level tangent, while the remaining 6½ miles winds through low hills on good grade and alignment.

The new base requires 40 cu. yd. of loose aggregate per 100 ft. station, 30 yards of which is clay and gravel



A Windrow of Clay and Gravel Aggregate

The old and new aggregates which have been deposited on the shoulder are mixed and bladed into the trench in a windrow located about 5 ft. from the outside edge. It is specified that any earth clods must be small enough to pass a 2-in. circular opening.

Following this, the remaining 8 ft. of base width is trenched 3 in. deep, and the material bladed into the windrow which the preceding operation established on the 14 ft. strip.

Bituminous Stabilizer and Water

As this job is in some respects experimental, three grades of asphaltic stabilizer were tried out—MC 4, SC 3, and emulsified MC 4—all meeting the requirements of Missouri Standard specifications. Of the three asphalts, the emulsion was found to produce a material decidedly easier to finish than either of the others, in spite of the fact that it was the worst in forming mud balls. The sheepsfoot tamper was responsible for this success, for it broke the balls so thoroughly that they made no trouble whatever.

Job specifications call for 2 gal. of stabilizer per sq. yd., or 12.2 gal. per cu. yd. loose measure, but as the work progressed this appeared too little, and was in-



A Rear View of the Plant

creased to a total of 13 or 14 gal. The same rate of application was used for all three asphalt types.

The quantity of water added varies from 27 to 50 gal. per cu. yd. according to the character and moisture



A Windrow of Finished Material Waiting to be Spread.

content of the aggregate. The greater the proportion of fines, the more water is required, the amount needed at any time being judged by the behavior of the materials in the mill.

The Graveling Plant and Its Operation

The distinctive equipment of this work is a Barber-Greene bituminous paver. Essentially it consists of an elevating loader and a pug mill, independently powered and mounted on separate crawler bases, but coupled together to operate as a unit.

This machine gathers the windrowed aggregate by a spiral feed at the foot of the elevator, raises it, and dumps it into the pug mill, where it is mixed with the bituminous stabilizer and necessary water, and finally discharged at the rear, in a windrow ready for spreading and compacting after it has cured sufficiently.

From the elevator, the material passes through a measuring opening which is adjusted according to the rate of pug mill operation. Water and asphalt are applied simultaneously to the aggregate as it enters the pug mill. The asphalt works best at a temperature around 170° F.

Final Distribution of Material

The windrow of finished material left by the traveling plant ordinarily is allowed to cure from 2 to 4 days according to atmospheric humidity. Rain may prolong the period indefinitely.

As the subgrade by this time has usually been somewhat disturbed, and also has accumulated more or less loose dirt, it is cleaned out with the patrol grader. This



Pneumatic Roller in the First Stage of Finishing.

is done first on the left, or narrow, side of the windrowed stock pile.

Next the entire windrow is pushed onto the freshly cleared space. This is done a piece at a time, in sections about ½ mile long, tractor and blade grader being used for the purpose.

Clearing of the right side of the subgrade follows, after which the base material is spread in final position. Its loose, or "fluff," thickness over the central portion of the road is then about 6 in. Compaction later reduces this to 4 in. Enough material is provided at the edges to make the required 7 in. finished depth.

The finishing operations which follow are conducted in the same ½-mile units as the preceding distribution of material.

Rolling, Tamping and Finishing

The first step in compaction is to roll the full width of base with a Bros 9-wheel pneumatic-tired roller under a 6-ton load. Four rounds are usually made. This is followed by 2 rounds with a sheepsfoot tamper, and then by a general shaping-up with the motor patrol follow in order as many times as may be necessary to produce a surface which will indent not more than one inch under the tamper. When this condition is reached, the surface is reshaped if necessary.

The final operation is rolling with a 10-ton roller. Considerable care is required at this point, as it is very easy to over-roll, with resultant breaking of material bond and shoving in places.

The road is kept open to traffic throughout these finishing operations, and becomes a completely cured base in about 2 weeks. The seal coat may be applied at any time thereafter, when temperature and drying conditions are correct. When this job was finished in October it was thought that volatiles had not escaped sufficiently to make immediate seal-coating desirable, and the final step was therefore postponed until next spring. Postponement of sealing has the further advantage of permitting closer study of the base following its first winter, and the repairing of any spots which may show weakness under traffic.

Operating Notes

The various operations described were carried on simultaneously so far as possible, but there were the inevitable occasions when rates of progress varied, and one division of the work would have to be stopped or slowed down until proper balance was again established. For this reason, the average number of men employed was less than 70, the total of the following tables.

Crew and Equipment

Men and machines employed by the contractor on the various stages of the work were as follows:

Base Preparation (One 12-hour shift)
- 1 foreman
- 14 men
- 1 75 H.P. crawler tractor pulling grader
- 1 12-ft. lade grader
- 1 motor patrol
- 1 60 H.P. crawler tractor pulling scarifiers
- 2 scarifiers
- 1 30 H.P. crawler tractor pulling harrows
- 2 disc harrows—tadem

Hauling and Windrowing Aggregate (Two 12-hour shifts) (Average haul for new aggregate, 4½ miles)
- 2 foremen
- 12 men (6 per shift)
- 1 crane ⅜ yard clamshell
- 1 hopper type scale
- 1 lighting plant at bin
- 3 trailer trucks—10 ton each

Mixing (Two 12-hour shifts)
- 2 foremen
- 26 men (12 per shift)
- 3 800-gal. water supply trucks (average haul 3 miles)
- 3 800-gal. liquid asphalt supply trucks (average haul 5 miles)
- 5 miscellaneous oil and water pumps
- 1 bituminous paver

Finishing (One 12-hour shift)
- 1 foreman
- 18 men
- 1 60 H.P. crawler tractor pulling grader
- 1 12-ft. blade grader
- 1 60 H.P. crawler tractor pulling tampers
- 2 sheepsfoot tampers
- 1 22 H.P. crawler tractor pulling pneumatic roller
- 1 9-wheel pneumatic tired roller
- 1 7-ton, 3-wheel roller
- 1 10-ton, 3-wheel roller

Engineering and Inspection

Due to the pioneering, or experimental, character of this project, an extra large engineering staff was maintained.

The project was carried out under the jurisdiction of the Missouri State Highway Department, C. W. Brown, Chief Engineer.

N. F. Tamm was project engineer in charge.

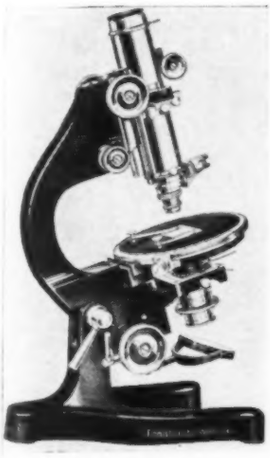


A Section of the Completed Base, Recently Opened to Traffic.

VALUE OF PETROGRAPHY IN DETERMINING QUALITY OF ROCK

By D. G. RUNNER

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Petrographic Microscope. (By Courtesy E. Leitz.)

ALL rocks are constantly being subjected to forces, both chemical and physical, that tend to destroy them. In contrast to these destructive forces, most rocks contain many qualities which give them the capacity to withstand this destruction. The capacity of a rock to endure the many destructive agencies is commonly known as durability. During the present time when unlimited quantities of rocks are being used daily in the construction of roads and structures, it is the duty of the engineer to know something of the durability, or "life expectancy" of his material. From all indications, the science of petrography should be of great benefit in determining this feature of rock strength and durability.

Quite often a sample of rock will appear perfectly sound and durable to the eye, while in reality it may contain harmful minerals that are known to be non-durable under freezing and thawing, temperature rise, or the decomposing action of the natural weathering agencies. In certain parts of the United States, sections of highways, portions of retaining walls, bridge piers, and other types of structures are showing the effects of the use of non-durable material. Some of this disintegrating action may not have occurred if a petrographic examination of the rocks had been made prior to its use.

The rocks making up the earth were formed in cycles. The earliest rocks were solidified from molten magma emanating from the interior of the earth. Upon exposure to weathering, and erosion, these igneous rocks in turn produced the sedimentary rocks. Continued burial of these igneous and sedimentary rocks altered their composition into the metamorphic types of rock. Elevation of these new beds of rock, together with weathering and erosion produced new sedimentary rocks, thus completing the cycle, inasmuch as the new rocks contained fragments of the original strata. Consequently there exists today, a great variety of rock offering contrasts in texture, mineralogical character, alteration products, etc. These various types of rock are given in Table I.

Petrography Defined

Petrography may be defined as the descriptive and systematic classification of rocks. This is accomplished with the aid of the petrographic microscope. At this time it might be well to describe briefly how the rocks are prepared for study by this type of microscope. Coarse-grained rocks, such as the granites, enable one to secure a comprehensive idea of the constituent minerals. However, the fine-grained rocks, such as the basalts, offer a more difficult task with respect to properly identifying the minerals contained therein. A study of the innermost sections of rocks often reveals textural and mineralogical conditions that are of great interest and practical importance.

The first step in studying a rock is to prepare a small piece so thin that one can see through it with the naked eye. The sample is prepared by breaking a small chip from the hand sample. This fragment is ground smooth by means of a revolving lap using an abrasive powder, such as emery. This smooth side is then cemented to a small glass slide, by means of Canadian balsam. The slide is then held and the rough side opposite is ground to smoothness. This grinding is continued until the rock slice is about 0.03 mm. in thickness, and at this point a thin cover glass is cemented on for protection. With the slide in this condition, and properly fixed in the microscope, an accurate idea of the texture and mineral content of the rock may be obtained.

The Application of Petrography

As stated in a previous article,[1] all rocks are subjected to weathering by natural agencies. Some materials are more susceptible to this weathering than are others. Each mineral of which a rock is composed has a different rate of expansion. The igneous rocks are composed of several different minerals, while the sedimentary rocks consist essentially of one mineral. The minerals of the former are usually interlocking, while those of the latter are united by thin coats of cementing material. Thus the unchanged sedimentary rocks are quite often less injured by temperature changes. Due to the inequalities in the rate of expansion in the different par-

[1]The Weathering of Rocks, by D. G. Runner, ROADS AND STREETS, vol. 79, No. 10, October, 1936.



Saw and Grinding Lap Used in Preparing Thin Sections of Rock. (By Courtesy of U. S. Bureau of Public Roads.)

Table I—General Classification of Rock. (From Bulletin 348, by E. C. E. Lord, U. S. Department of Agriculture, 1916.)

CLASS	TYPE	FAMILY
Igneous	Intrusive (Plutonic)	Granite, Syenite, Diorite, Gabbro, Peridotite
	Extrusive (Volcanic)	Rhyolite, Trachyte, Andesite, Basalt, Diabase
Sedimentary	Calcareous	Limestone, Dolomite
	Siliceous	Shale, Sandstone, Chert (flint)
Metamorphic	Foliated	Gneiss, Schist, Amphibolite
	Non-foliated	Slate, Quartzite, Eclogite, Marble

ticles, stresses are set up which tend to disrupt the rock. Other actions which hasten the rock's decay are: Solvent action of water, carbon dioxide, sulphurous acids, wedging action of roots, organic acids, mechanical abrasion, etc.

Granites.—Regarding the granites, Washington states[2] that "almost any light colored more or less coarse grained non-foliated igneous rocks is called granite by quarrymen, irrespective of its composition, whereas to the petrographer granite denotes a definite species of coarse grained igneous rock, composed of quartz, alkali (mostly potash) feldspar, and white or black mica or both, in some cases other dark minerals taking the place of the mica. The mineral that is most hurtful to the quality and lasting power of granite is the sulphide of iron, pyrite. On exposure to the action of air and rain this oxidizes, the sulphur forming sulphuric acid, which decomposes the feldspare of the rock and thus disintegrates it, while the iron oxide forms a brown stain. If pyrite is present in granite it is almost always in such small amount and in such small grains that in spite of its usual bright brassy luster, it is seldom visible to the naked eye or by using a hand lens, but its presence is clearly shown under the microscope in the thin section."

Another mineral common to granites, is biotite, or black mica. This mineral alters readily but its effect upon durability of the granite is not so marked as in the case of the pyrite and feldspars. Biotite alters in several ways. It may change in color from brown to green while still retaining its mica character, the optical constants changing with the chemical change. The most common alteration is to chlorite, but retaining the peculiar cleavage. Quite often the alteration is accomplished by the deposition of lenticular aggregates of carbonates between the laminae of the mica.

Another mineral in granite which is easily altered, is orthoclase feldspar. This mineral is composed essentially of potassium-alumina-silicate, with some replacement by sodium. The process of alteration is not likely to be the same in all instances, but usually commences along the cleavage cracks, and when it has progressed very far, the whole mass appears cloudy when viewed through the microscope. The common alteration products are muscovite (sericite), or kaolin, and quartz. Hence the microscope shows at once, by the clouded feldspar, whether or not the rock is fresh, or has begun to weather. Nephelite, a mineral somewhat akin to the feldspar family, when found in the so-called "granites" of the quarrymen, weathers much more readily than the feldspars and is consequently harmful to the durability of the rock. Pyroxene and amphibole are more durable constituents of the granites, than the black micas, although when long exposed they decompose and disintegrate slowly. Those varieties rich in iron weather most readily, and because of larger percentages of iron oxide resulting from the decomposition, are classed as undesirable.

Limestones and Marbles.—Limestones and marbles are further examples of rock that to the eye appear to be pure and unadulterated. However, upon examination by the petrographic microscope, are quite often found to contain minute particles of pyrite, or marcasite. Here again the sulphuric acid produced by the oxidation of the iron disulphide reacts with the calcium carbonate to cause decomposition of the rock. Marcasite, another iron disulphide is even more harmful than pyrite because of the rapidity with which it oxidizes and decomposes. The clay contained in some limestones is not visible to the eye, but is readily discernible with the microscope. This constituent (clay) of some limestones has been the cause for unsoundness when used in concrete.

Chert.—Chert is another material that is used quite extensively in certain parts of the United States. It is quite often found in limestone and dolomite deposits, and in addition, is found in many deposits of gravel. Its durability when used in concrete has been questioned by some authorities. Chert is composed essentially of opaline silica together with some impurities such as calcite, pyrite, organic matter and so forth. To the eye, chert appears to contain nothing but the silica, but an examination by the microscope sometimes yields disseminated pyrite, and minute fractures, which may be partly responsible for the reported failures of chert in service.

Kriege states[3] "one of the most common minerals associated with cherts is pyrite. This has been seen in every chert sample examined by the author. In most cases it is microscopically visible, some samples having

[2]How Petrography Can Aid the Stone Producers, by H. S. Washington, The Explosives Engineer, October, 1925.

[3]The Stability of Chert, by H. F. Kriege, Rock Products, vol. 32, No. 9, April 27, 1929.

Table II—Alteration Products of Some Common Rocks

Mineral	Formulae	Alteration product
Pyrite	FeS_2	Oxide of iron
Magnetite	Fe_3O_4	Hematite, limonite
Ilmenite	$FeTiO_3$	Leucoxene
Quartz	SiO_2	None
Enstatite	$MgSiO_3$	Serpentine
Chrysolite	$(MgFe)_2SiO_4$	Serpentine
Augite	$RSiO_3$	Chlorite, serpentine
Hornblende	$RSiO_3$	Chlorite, talc, serpentine
Biotite (mica)	$(HK)_2(MgFe)_2Al_2(SiO_2)_3$	Chlorite
Muscovite (mica)	$H_2KAl_3(SiO_4)_3$	None
Orthoclase(feldspar)	$KAlSi_3O_8$	Kaolin, muscovite
Plagioclase (feldspar)	$NaAlSi_3O_8$	Kaolin, zeolite
Sodalite	$3NaAlSiO_4NaCl$	Sericite
Tremolite	------	Talc
Zircon	ZrO_2SiO_2	None

been found in which the pyrite crystals are several millimeters in length. A very finely divided pyritic mass is sometimes seen coating a chert piece and giving it a brassy green color. More often these sulfide minerals are, as microscopic units, distributed as a specular deposit throughout the mass or in seams and planes. These pyritic bodies soon become oxidized on exposure of the chert and grow into dark iron oxide spots and in time stain the chert mass yellow or brown."

Argillaceous Limestones.—Argillaceous limestones, or those containing fairly large percentages of clay, have been known to cause disintegration when used in concrete. Miller[4] states that "* * * a concrete road and a retaining wall where the stone had been used went to pieces after a few years and the cause was traced to the disintegrating effect of the limestone aggregate. Careful microscopic work showed the presence of considerable argillaceous matter, especially the mineral beidellite, which has adsorptive and absorptive properties. The rock fragments in the concrete road were wet after each rain and with the clay absorbing an undue amount of moisture the rocks were shattered after a limited number of freezings." Lang[5] holds that the "use of argillaceous limestones as coarse aggregate in concrete subjected to exposure has probably resulted in more concrete failures than could be attributed to the use of any other unsound type of aggregate."

Sandstones.—In the case of sandstones, it is not so much the mineral content that may cause failure, as it is the shape of the grains and the cementing material that binds the grains together. The mineral quartz, in more or less rounded grains, is by far the most abundant constituent of sandstone. This is due to the fact that the chemical processes of weather do not destroy quartz, except with extreme slowness. The other constituents of sandstone include feldspar, mica, and such accessory minerals as zircon, magnetite, hematite, etc. In such instances where the feldspar amounts to more than about 5 per cent, the rock is usually called "feldspathic sandstone."

The kind of cementing material between the grains of sand greatly affects the durability of the rock. A cementing media or silica produces a hard rock, while calcium carbonate cement produces one less durable. In addition, argillaceous, ferruginous, and gypsum may also act as binding cements. The argillaceous cement does not form a strong bond, and when it is abundant, the sandstone tends to break down into sand. Many sandstones contain layers in which flakes of white mica are abundant. This mica may be mixed with clay material, and may cause the rock to split into thin slabs. The value of the cementing media depends chiefly upon its adhesive and cohesive powers. It may be observed that sandstones with silica cement, or limestones with little or no quartz, are relative strong and durable. Apparently the reason is due to the fact that the force binding like substances is stronger than when uniting unlike materials.

The microscope will readily detect this cementing media and, with the character and shape of the individual constituents determined, the probable durability of the rock can be stated. In discussing the durability of aggregates, Walker[6] states that "certain shales, soft loosely bound sandstones, argillaceous sandstones and

[4]Limestones of Pennsylvania, by B. L. Miller, Bulletin M20, Penn. Topographic & Geologic Survey, 1934.
[5]Report on Significance of Tests of Concrete and Concrete Aggregates, A. S. T. M., p. 98, 1935.
[6]Report on Significance of Concrete and Concrete Aggregates, A. S. T. M., p. 75, 1935.

PETROGRAPHIC DESCRIPTION

I. FIELD NOTES
ORIGINAL NO. 11A LOCALITY Westerly, Rhode Island
OCCURRENCE:

II. HAND SPECIMEN DESCRIPTION
GENERAL APPEARANCE: Fine grained pink rock consisting of feldspar, quartz, and biotite

III. MICROSCOPIC STUDY FOR CLASSIFICATION
TEXTURE: Hypidiomorphic SIZE OF GRAINS
ORIGINAL STRUCTURE: Cooled from magma
PRIMARY PROCESS REPRESENTED:
SECONDARY STRUCTURE:
SECONDARY PROCESS REPRESENTED:

MINERALOGY (MINERALS ARE GROUPED FOR INTERPRETATION PURPOSES AND ARE ARRANGED IN EACH GROUP IN APPROXIMATE ORDER OF ABUNDANCE; IN SOME CASES APPROXIMATE PERCENTAGES ARE GIVEN)

(A) PRIMARY ESSENTIAL MINERALS	%	(B) SECONDARY ALTERATION PRODUCTS	%	(C) METAMORPHIC RECRYSTALLIZATION MINERALS	%	(T) TERTIARY CHANGES AND ENRICHMENT EFFECTS
Quartz	45	Chlorite				
Plagioclase	10	Sericite				
Orthoclase	15					
Biotite	15					
Muscovite	4					
Microcline	10					
(T) ACCESSORY MINERALS				(D) INTRODUCED SUBSTANCES OR MINERALIZATION		
Magnetite	1					

SPECIAL FEATURES:
Some of the biotite mica has been bleached into chlorite.
Microcline shows lattice twinning.

ORIGIN OF THE ROCK: Plutonic
CLASSIFICATION: Biotite granite

Data Sheet Used in Describing a Rock Determined from a Thin Section

limestones, ochers, etc., are typical of unsound aggregate particles causing pits. Their effect on the durability of a concrete structure is approximately in proportion to the amount of pitting which occurs. For ordinary quantities of unsound particles of this nature, the surface pits are usually the only obvious effect. Large proportions of such unsound particles, however, may lead it to progressive disintegration, particularly in the wear surface of concrete road slabs."

Marbles.—Marble (or crystalline limestone) is usually considered to be the metamorphic equivalent of limestone, chalk, etc. It is quite definitely distinguished from limestone by the crystalline and coarse-grained structure. However, we have dolomite marbles as well as the calcitic (or limestone) marble, but the distinction is not apparent to the eye, and a chemical or petrographical analysis is usually necessary to bring out the real difference between the two marbles. The durability of calcitic and dolomitic marbles may be traced back to accessory minerals present in the limestone or dolomite. The chief varieties of limestone based on mineral composition are named from the accessory minerals, which are cited below:

Accessory Mineral	*Variety*
Aluminum silicate	Argillaceous limestone
Siderite	Ferruginous limestone
Detrital quartz	Arenaceous limestone
Chalcedony	Cherty limestone
Glauconite	Glauconitic limestone

A relatively pure limestone, when metamorphosed, may develop into a compact marble, but the impurities shown in the above table produce a broad range of end products. For example, if quartz is the only major



Photomicrograph of Impure Limestone from Perry County, Illinois. The Calcite Mostly in the Form of Shell Fragments, Has Been Dissolved by Dilute Hydrochloric Acid, Leaving the Insoluble Material in Its Original Position. The Large White Areas Mark the Former Presence of Calcite. The Small Light Gray Angular Grains Are Mostly Quartz with a Little Feldspar. The Jet Black Grains Are Pyrite of Iron Oxide Derived from Pyrite, and the Dark Gray Fine Felty Material Is Mainly Beidellite. The Short Linear Aggregates of the "Beidellite," and the Manner in Which Some of Them Coat the Larger Calcite Grains Indicate a Low Resistance to Freezing. (Reproduced by Permission from "Usefulness of Petrology in the Selection of Limestone," by G. F. Loughlin, Rock Products, March 17, 1928.)

impurity, it may react with calcium carbonate to form wollastonite.

Dolomite is essentially a double carbonate of calcium and magnesium. However, this condition is never quite attained to perfection in nature, as there is usually some impurities existing in the rock. For example, the effect caused by metamorphism on the siliceous or argillaceous impurities may be illustrated by the following equations:

Dolomite + silica = calcite + forsterite + CO_2.

With an increase in the quantity of silica, the following reaction takes place:

Dolomite + silica = diopside + carbon dioxide.

With alumina as an impurity the reaction is as follows:

Dolomite + alumina = spinel + calcite + carbon dioxide.

Common usage leads one to believe that there is no difference between marbles, however, petrographically there is a decided difference between the two types of marbles as shown by the impurities in the original limestone or dolomite.

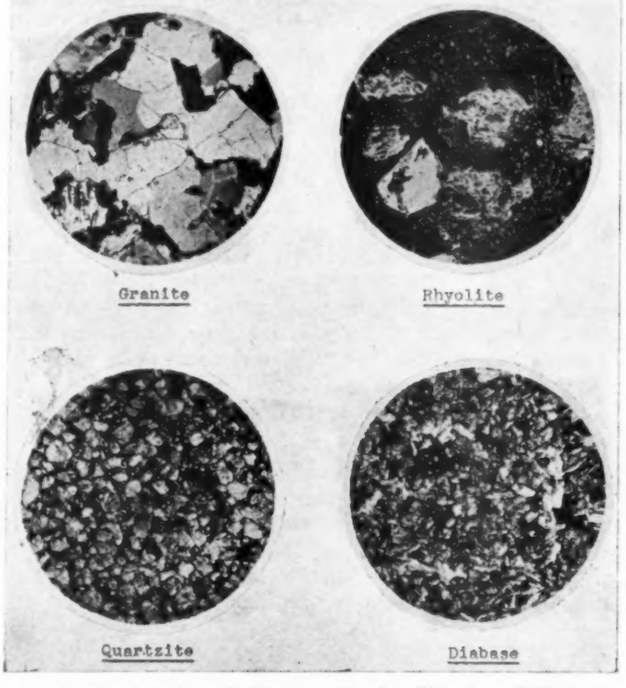
Gneiss and Schist.—Of the metamorphic rocks, the foliated varieties such as gneiss and schist are more liable to cause trouble. Loughlin[7] states that "the outstanding feature from the standpoint of weathering is the foliated structure. The more finely foliated a rock is, the greater is its tendency to crush into small scaly fragments undesirable for concrete aggregate. Concentration of the micaceous minerals along foliation planes furthermore tends to promote disintegration. The comparatively small amount of mica in gneisses and some schists renders them less subject to disintegration than the highly micaceous schists. Unusually fine-grained schists that appear to consist entirely of mica may exfoliate appreciably after a few months of exposure in humid regions. The beginnings of weathering may extend a considerable distance below the surface of outcrops, and rock that looks satisfactory when newly quarried may soon begin to disintegrate."

[7]Qualifications of Different Kinds of Natural Stone for Concrete Aggregate, by G. F. Loughlin, Proc. Amer. Concrete Inst., vol. 23, 1927.

The Effect of Rock Texture

The texture of rocks depends upon the shape, size, physical condition and the manner of arrangement of the constituents. As the durability of a rock is in part at least, a function of the texture, it is obvious that this feature has a bearing upon the rock's ability to withstand destruction. For example, a coarse-grained sandstone consisting of well rounded grains, would not be as durable as an extremely dense, fine-grained sandstone. Likewise a coarse-grained granite, would be less durable than a dense diabase or basalt. The uniformity and size of the mineral particles influence the manner in which the rock weathers. For example, in a porphyritic granite, the large crystals of feldspar decompose more quickly than the smaller ones, thus pitting the surface of the rock. This differential weathering is usually noted in coarse-grained rock composed of minerals of varying degrees of hardness.

The type of textures of sedimentary rocks are usually limited to fine-, medium-, or coarse-grained. In other words, the texture is usually of nearly uniform character in contrast to the many-sized crystals found in igneous rocks. Because of this feature, the discussion herein will be confined chiefly to igneous rocks. As stated previously, the texture of a rock depends chiefly upon the mode of formation as shown by the grain size, shape and arrangement of the minerals. At the outset, the chemical composition of the magma is reflected in the texture of igneous rocks because upon this feature depends the minerals that are finally formed. Magmas cooling beneath the earth crystallize slowly. In contrast to this condition, the lavas pour out on the earth's sur-



Photomicrographs of Various Rocks Showing Different Textures. (From Bulletin 348, by E. C. E. Lord, U. S. Department of Agriculture, 1916.)

face, and cool quickly, so quickly in fact that the magmas sometimes form glass. Between these two extremes of slow, and of rapid cooling there occur all gradations of texture.

One common textural name is "granular." This term is applied when most of the constituent minerals are about of the same size, such as found in the granites. Rocks more basic in composition than the granites, show different textures, due to the difference in the order of crystallization and the absence of quartz. "Porphyritic" texture refers to that texture exhibited by large crystals, fragments or flakes contained in a dense groundmass. Here the crystals have had opportunity to grow unimpeded by other mineral crystals. "Micrographic" texture refers to the structure produced when quartz simultaneously crystallizes with another mineral, the two interpenetrating, thus giving a mottled appearance as exemplified in graphic granite. "Flow" texture is common to the glassy groundmass of extrusive rocks, and has been produced by the cooling of the lava in swirling lines. There are other textural terms such as, "ophitic," "cataclastic," and "poikilitic," but these are restricted more or less to special cases and will not be considered here.

Conclusions

Whenever it is possible, the engineer should visit the quarry site to note and to examine the degree of rock weathering. This examination is particularly advisable in an old quarry where rock debris has been exposed to the weather. Such features in the rock as, laminations, schistose structure, and weathered minerals may be seen with the unaided eye. The weathered feldspar in granites is very discernible inasmuch as it is usually soft, yellowish to white in color, and is found scattered throughout that portion of the rock directly exposed to the elements. It is not the intent that an examination of the quarry will determine whether a rock is durable or not, but such an examination in connection with a petrographic study will give a fairly definite idea of the lasting quality of the rock.

Loughlin states[8] that "this general review of the weathering qualities of natural rocks used as concrete aggregates shows that most of them, if free from weathering, are satisfactory; that certain minerals, particularly the clay group and certain zeolites are very objectionable and that others including micas concentrated in fine grained flaky masses and calcite in finely disseminated grains among other minerals may promote disintegration under certain conditions; that certain textures and structures, notably fragmental texture and shaly structure in sedimentary rocks, flow structure in volcanic rocks, and highly schistose structure in metamorphic rocks, aid in the disintegration of rocks that are mainly composed of durable minerals."

This microscopic study enables an estimate to be made of the probable durability of the aggregate. Minerals may be identified, so that with a knowledge of their characteristics, an approximation may be made of the rock's durability. Rock features such as segregations of clay, weathered feldspar, mica, variations in texture, kind of cementing medium, shape of particles, etc., have an important bearing upon the rock durability.

It is realized that this paper has of necessity treated the subject matter in the briefest manner. For more detailed study of the petrographic microscope, and the question of durability of aggregates, the list of references appended hereto should be consulted.

[8]Op. cit. See footnote 7.

BIBLIOGRAPHY

(*On the petrographic microscope*)

1. Thin-Section Mineralogy, A. F. Rogers and P. F. Kerr. McGraw-Hill Book Company, New York, 1933.
2. Minerals in Rock Sections, L. M. Luquer. D. Nan Nostrand Company, New York, 1925.
3. Making Thin Sections of Rocks, Mary Keyes. American Journal of Science, 5th Ser., vol. 10, 1925.
4. Petrology for Students, A. Harker. Cambridge University Press, London, 1923.
5. Petrographic Methods and Calculations, A. Holmes. Thomas Murby & Company, London, 1921.
6. Petrographic Methods, E. Weinschenk. Mc-Graw-Hill Book Company, New York, 1912.

(*On the application of petrography*)

7. Durability Studies of Aggregates and Concrete, H. F. Gonnerman and G. W. Ward. National Sand and Gravel Bulletin, vol. 12, no. 5, 1931.
8. Usefulness of Petrology in the Selection of Limestones, G. F. Loughlin. Rock Products, vol. 31, no. 6, 1928.
9. Qualification of Different Kinds of Natural Stone for Concrete Aggregate, G. F. Loughlin. Proc. American Concrete Institute, vol. 23, 1927.
10. How Petrography Can Aid the Stone Producers, H. S. Washington. The Explosives Engineer, Oct., 1925.
11. Interesting Case of Dangerous Concrete, J. C. Pearson and G. F. Loughlin. Concrete, vol. 22, p. 144, 1923.

(*General references*)

12. Report on Significance of Tests of Concrete and Concrete Aggregates. Symposium American Society for Testing Materials, 1935.
13. Influence of Coarse Aggregate on the Durability of Concrete, F. R. MacMillan and G. W. Ward. Symposium on Mineral Aggregates, American Society for Testing Materials, 1929.
14. Non-Bituminous Road Materials, L. Reinecke. Economic Geology, vol. 13, no. 8, 1918.
15. Relation of Mineral Composition and Rock Structure to the Physical Properties of Road Materials, E. C. E. Lord. Bulletin 348, United States Dept. Agriculture, 1916.

Book Review

Asphalt Roads by P. E. Spielman, Ph. D., British representative of the International Committee for the Standardization of Nomenclature and Tests of Road Materials; and A. C. Hughes, B. Sc. (Eng.), County Surveyor for Hampshire. Published by Longmans, Green & Company, 114 Fifth Avenue, New York. 319 pp., 5¼ in. by 9 in. Price. $9.00.

A statement of the table of contents will indicate the nature of this book:

Part I

Historical Introduction

French Deposits, German Deposits, Italian Deposits, Swiss Deposits, The Trinidad Asphalt Lake.

Part II

Asphaltic Bitumen and Natural Asphalt Origin; Nomenclature; Constitution and Properties; The Colloid State; Chemical Constitution; Sulphur; Paraffin Wax; Blown Bitumin; Fluxing and Blending; Bituminous Binders; Methods of Examination; Sampling Properties and Tests; The Raw Material.

Part III

Bituminous Mixtures

Asphaltic Bitumin and Tar Mixtures; Rubber Asphalt Roads.

Part IV

Mineral Aggregate; Filler-Bitumin Relations; Surfacings; Hot Process Asphalt; Types of Surfacing; Plant and Tools; Faults; Repairs.

Part V

Analysis and Testing

Analysis; Recovery of Asphaltic Bitumen; Mechanical Testing.

Appendices

Apparatus for Field Laboratory; Information; British Standard Specifications.

OBSERVATIONS BY THE WAY

By A. PUDDLE JUMPER

¶ An innovation in brick paving construction practice was tried out this past year. The brick were laid longitudinally with the center line. The experiment will be watched for results. Smoother riding is claimed for the method.

• •

¶ If you want to inspect an excellent concrete highway built to a modern engineering design take a drive over U. S. No. 112 west out of Coldwater, Michigan.

• •

¶ A. Puddle Jumper is critical on signing of highways. Michigan has some excellent engineering on their highways but the signing, I think, is poor. P. J. has to inquire at filling stations to find out what town he's in.

• •

¶ Bill Moseley, Poston-Springfield Brick Co., Springfield, Ill., says the reason his idea for promoting the use of brick by using the picture of a pretty girl holding a brick never went over so good when he explained it to the manufacturers was because they misunderstood what he said. How about it, Bill, am I right?

• •

¶ If you want to hear a good story ask Geo. Schlesinger, Director of the National Paving Brick Association, to tell you about the Italian on the train taking his family to Worcester, Mass. The train passed through Woonsocket on the way and George says the baby got its dinner.

• •

¶ Traffic lane line marking on the San Francisco-Oakland Bay bridge is by small square white tiles inset in the surface of the upper deck which is 6-inch light weight concrete, six lanes wide (58 feet).

• •

¶ Did you see Koppers' new pocket size handbook? Tables are given and useful data on tar in roadbuilding are explained.

• •

¶ This summary, prepared by the Chicago Surface Lines, covers only five intersections, all of which pass more street cars than the figures mentioned on page 54 of the December issue in the Puddle Jumpers remarks. While there may be still other intersections with more than 275 street cars per maximum hour, I imagine this is about the entire list.

STREET CAR FLOW—CHICAGO

Intersection	No. Cars Max. Hour	No Left Turns	No Right Turns	Straight-Thru	January—1937 Remarks
1. Milwaukee, Grand & Halsted	491	0	0	491	3 streets intersecting in common point — left turns prohibited. Assorted cars on one street
2. Clark & Center & Ogden	344	52	56	236	Large 3 street intersection. Assorted cars
3. Clark & Archer	338	38	76	224	Diagonal intersection—2 street. Assorted cars
4. Clark & Division	312	55	56	192	Ordinary 2 street intersection. Assorted cars
5. State & Lake	284	75	90	119	Ordinary 2 street intersection. Assorted cars

• •

¶ Why are contractors on Mississippi road work who have bid on creosoted timber work howling so loudly?

• •

¶ Can you give the official name for Rhode Island? It is "State of Rhode Island and Providence Plantations." Such a big handle for such a little pan.

• •

¶ North Carolina's last biennial report, 1935-36, has just been received. It is a creditable volume. P. J. would liked to have seen some discussion on North Carolina's state highway economics included and statements as to what are meant by betterments and maintenance.

¶ After puddle jumping — even swimming through several states it was with an exhilarated feeling that I "stepped on the gas" when I hit those well signed, smooth concrete roads in Indiana. A highway well posted with illuminated traffic control devices and signs giving the names of the towns instills a feeling of security for the night driver no matter how heavy it might be raining or icy the pavement might be.

¶ Before and Ten Years' After, Dunedin Isles, Fla. The brick surface on Ocala rock base is standing up in wonderful shape.





¶ Who originated the mastic cushion idea for brick paving? When was it first used? Ask Geo. Martin, Consulting Engineer, The Barrett Company.

• •

¶ When was the first International Good Roads Congress? Says my friend, Edward N. Hines, Road Commissioner of Wayne County, Michigan, who has held that post for over 30 years:

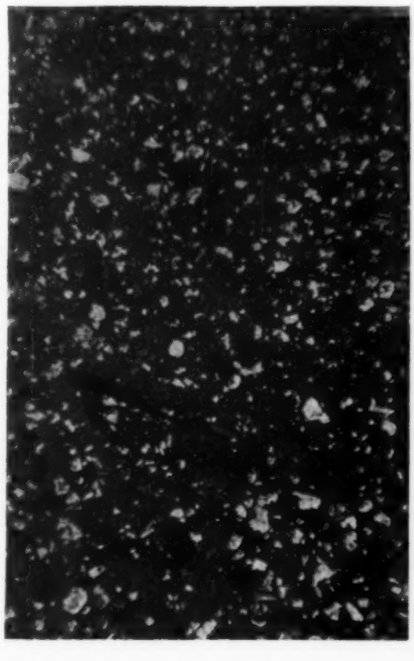
"I am mindful of the first International Good Roads Congress that was "pulled" off at Port Huron, Michigan, back in 1899. The one thing that made it international was the fact that two Canadians attended from Sarnia, Canada, which is directly across the river from Port Huron."

• •

¶ A. Puddle Jumper took a couple of dozen pictures of flooded roads and bridges but—blankety! * * * blank—the film came out blank.

• •

¶ Ten years ago I finished a pavement job in Dunedin Isles, Fla. Brick, concrete, and hot-mix asphalt. Topeka mix, using the then Ohio specification, was laid. The picture shows the condition of the Topeka mix surface today. The surface is quite badly cracked and checked due to lack of traffic. I am rather proud of the engineering job I did there ten years ago. Another picture herewith shows a brick street, Rowena Ave., Dunedin Isles. A. Puddle Jumper's car is in the foreground. This car jumped many puddles—yea, torrents, in the flood district on the return to Chicago.



¶ Tennessee is now in the stage of personnel changes due to new appointments. Shakeup is not complete yet, but it appears like Mr. Goetz will hold over as chief engineer. Mr. M. O. Allen is the newly appointed Commissioner of Highways and Public Works.

• •

¶ We know that the subject of highway safety with its mounting death and injury toll is a vital question to the American people, and we feel that real highway safety must be considered from three sides—the driver, the vehicle and the road. Believing that few have realized the importance of the highway itself in this triangle, we have endeavored to bring this side to their specific attention. In this campaign more than 200 stations in all of the country have participated and more than 440 broadcasts have been presented. The response to this program has been most gratifying and the reports on its reception throughout the nation have justified our efforts.—C. M. Upham, American Road Bldrs. Assn.

• •

¶ Florida is building bituminous roads that are not black top and are certainly smooth riding. They are the color of the aggregate used. It was a pleasure to drive from Jacksonville to Perry, Fla. The cross section might be said to be "streamlined." Fine work, Florida.

• •

¶ Says J. R. Phillips, Dist. Engr., Wyoming State Highway Dept., Casper, Wyo.—" . . . trust that you will visit us at some time when puddle jumping." He sent A. Puddle Jumper one of their colored, descriptive, beautifully detailed maps of the state highway system showing historic spots, national parks, rivers and mountains of the great, wide open spaces of Wyoming.

¶ On that road along the west coast of Florida, south of Dunnelon, cattle and other stock range territory on both sides. On each side of some of the towns you will notice cattle crossing preventives built into the road surface. That's the first time P. J. ever saw cattle guards on a highway.

• •

¶ In my rapid travel through the flood zones I noted that bridges and highways were standing up very well. Of course, an estimate of flood damage can be made only after the waters recede. But quick inspection revealed little damage. Considerable debris had collected in guard rails and on bridge bottom chords but that will be only minor damages.

• •

¶ Commendable, creditable work was done by the state highway departments of Indiana, Kentucky and Ohio, to my personal knowledge, in helping evacuation of flooded areas and keeping through traffic moving. These maintenance men and engineers worked through long night hours without relief to bring people and their goods to higher, safer ground. Right here it might be suggested that all state highway departments set up plans for conversion to disaster relief agencies. Their well-knit widespread organizations are able to function upon a moment's notice if a plan were adopted.

• •

¶ Coming across Indiana one dark night during the recent sleet and snow storm I passed a snow plow about midnight. The left-hand dash lamp was a bright red light and the right-hand lamp a bright yellow sodium light. A swell idea, I claim.

• •

Some State should sponsor a comprehensive guard rail test.



TRAFFIC SIGNAL CONTROL OF HEAVILY TRAVELED INTERSECTION

By ROBERT A. MITCHELL
Traffic Engineer,
City of Philadelphia, Pa.

CAN a heavily traveled intersection be controlled more efficiently by the installation of traffic signals correctly operated by an automatic timer, by manual operation of the signals by a police officer or by the officer without the use of electrically operated signals? This has always been a controversial subject among police officials and engineers interested in traffic control. The installation of hundreds of automatically controlled traffic signals and signal systems in recent years seem to indicate that the first method is gaining favor in most communities.

Figure 1 is a diagrammatic plan of the multiple intersection on the east side of the Girard Avenue Bridge over the Schuylkill River in Philadelphia showing the flow of traffic. Volume counts made in 1934 indicated that over 37,000 vehicles traversed this intersection from 7 a. m. to 7 p. m. on a normal day, thus ranking it as the third most heavily traveled intersection in the city. In fact, for the entire year the Girard Avenue Bridge carries more traffic than the well-known Delaware River Bridge connecting Philadelphia with Camden, N. J.

Types of Traffic Carried by Bridge

The types of traffic carried by the Girard Avenue Bridge have quite a bit of bearing on the problem and should be understood. Girard Avenue is one of the most important cross town streets in the city and is used by a great many commercial vehicles, especially large trucks and trailer trucks; by one of the most important line of street cars with rather frequent headways; and by a morning, afternoon, and evening peak load of private passenger vehicles of business men and theatre goers from the suburbs along the main line of the Pennsylvania Railroad and the northwest residential section of Philadelphia.

The traffic at this location has been controlled for many years by a traffic officer. Figure 2 shows the traffic movement under such conditions. The officer using

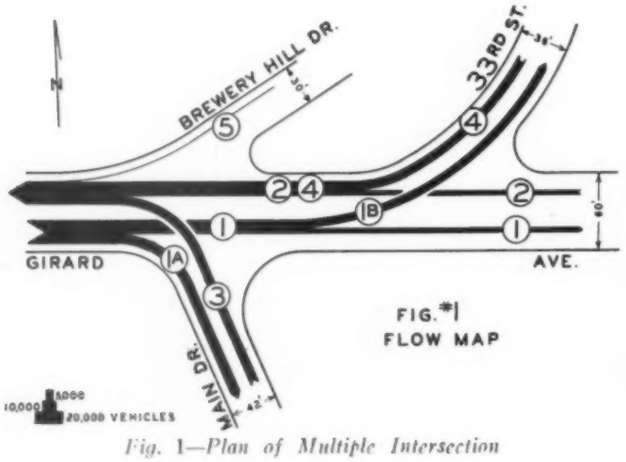


Fig. 1—Plan of Multiple Intersection

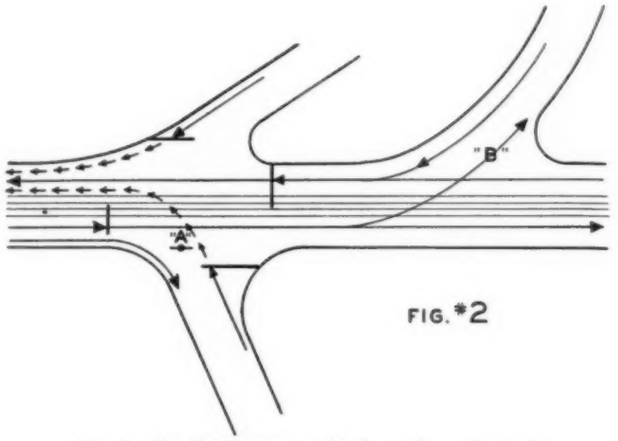


Fig. 2—Traffic Movement Under Officer Control

a hand semaphore signal was stationed at point "A." The unbroken lines indicate the movement of traffic on one "go" period and the broken lines show the movement during the other phase. Stop lines are also shown. Proper lane markings and signs were provided to allow the vehicles in Flow "1A" to make a right turn at any time. Very few pedestrians use this intersection.

In spite of the heavy volume of traffic, very little confusion was apparent, except during the morning, afternoon and evening peak hours, because it was only at these periods that the traffic in flows No. 3 and No. 4 became heavy. The Girard Avenue traffic is fairly steady during the entire day, but as long as there was no interference from cross traffic it had no difficulty in moving without control. During the peak hours, however, especially from 4:30 to 6:30 p. m. when the traffic in flow No. 3 was exceptionally heavy, all entering streets were usually clogged with vehicles and the traffic officer experienced great difficulty in moving traffic through the intersection.

Causes of Traffic Confusion

A study of traffic conditions at the corner showed that the main reasons for this confusion were the sequence or order in which the different flows of vehicles were being moved and the fact that the officer could not control the entire intersection. No advantage was being taken of the possibilities of merging the traffic in flow No. 3 with the westbound Girard Avenue traffic and it was impossible for the officer to control traffic at the part of the intersection marked "B" where a large portion of flow No. 1 turned north across the vehicles in flow No. 2. In other words, the traffic was being moved exactly opposite to the well-known and established principles of vehicle control, in that two streams of traffic were allowed to cross without any form of control at one location, whereas at the other point, where two streams of traffic could merge without undue loss of

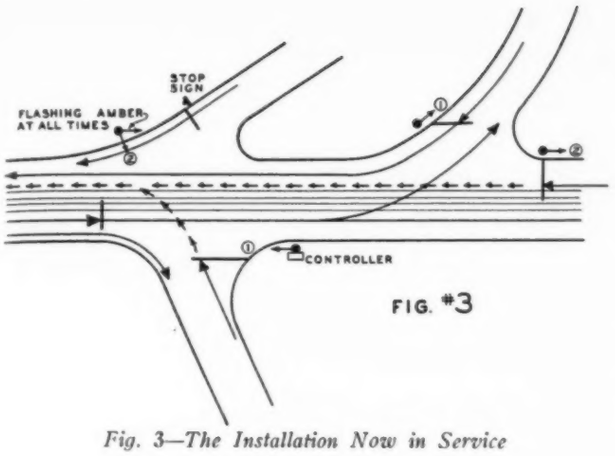


Fig. 3—The Installation Now in Service

efficiency, they were only allowed to move at separate intervals under control. The latter movement did not affect the confusion, however, as much as the former. The direct crossing of streams No. 1B and No. 2 really caused most of the difficulty since there was a continual jockeying for the right-of-way. Whenever the motorists in flow No. 2 managed to get the break they continued to flow as long as there were vehicles in line and often held back the vehicles in stream No. 1B to such an extent that traffic was tied up even back on the bridge and the vehicles in streams No. 3 were unable to cross.

Anyone might wonder why the officer did not hold up the eastbound Girard Avenue traffic at the end of the bridge, when he saw the traffic piling up. The fact of the matter was, the blockade happened so quickly that the intersection was tied up before the officer realized it. Also in order to relieve the congestion at point "B" he had to continue to let the traffic in streams No. 2 and No. 4 flow. Therefore, as long as stream No. 3 couldn't flow he continued to give the right-of-way to the eastbound traffic in hopes that flow No. 1B would finally get loose and allow the backed-up traffic to move. This policy of moving traffic for fairly long intervals of time or until all the cars in the particular stream have been cleared out, is generally adhered to by most human beings controlling traffic, yet studies will show that it is not the most efficient method.

This intersection should have been signalized several years ago, not so much from an accident standpoint but to more efficiently control traffic. However, very little was done in the way of improving traffic conditions in the last few years due to the unsympathetic attitude of the city administration. The Honorable S. Davis Wilson was elected mayor of Philadelphia this year and under his energetic guidance and sympathetic support great strides are already being made in traffic safety control. It is really due to this "traffic minded" attitude of the present administration that we were able to finally signalize this intersection.

Detailed Analysis of Traffic Movement Made

In order to control the traffic as smoothly as possible under traffic signal control, a detailed analysis was made of the movement of traffic, as it was handled under manual control. Lane volume counts, speed checks and headways were observed and the time the officer allowed for each movement of traffic was ascertained for the hours of peak traffic movement. The results indicated that traffic could be moved much more efficiently by using the method as shown on Fig. 3. The signals and one STOP sign were accordingly installed, as shown on this drawing, and the signals operated by an automatic 2-street timer provided with manual control for emergencies. The streams of traffic shown on Fig. 3 by solid lines moved during the one "go" phase of the cycle and those shown with broken lines moved during the other phase. The traffic in stream No. 1A was still allowed to make a right turn at any time and as practically all of the motorists in flow No. 5 wished to make a right turn, it was felt a STOP sign could easily control their movements without the danger of a collision.

The most outstanding differences between the two systems were that stream No. 2 was stopped at the eastern part of the intersection while streams No. 1B and No. 4 were moving, thus eliminating a point of contact between opposing flows of vehicles and at the main intersection the traffic in stream No. 3 merged with the traffic in stream No. 2. It was felt that this was a step forward since experience has shown that vehicles can weave without serious delay or accidents, whereas an angular crossing of opposing vehicles causes confusion and numerous collisions.

Numerous studies and experiments with signal timing have convinced us that more satisfactory results are obtained by operating 2-street traffic control signals under short cycles of 40 or 50 seconds, rather than long cycles usually used under hand control. The timer at this location was set up for a 50-second cycle with about 55 per cent of the time allotted to the traffic in streams No. 1 and No. 4.

The second day after the signals were placed in operation, complaints started to pour into the traffic engineering office from irate motorists who claimed the system was so confusing that they were unnecessarily delayed and that many minor accidents such as "side swipes" and "rear ends" were occurring. It was anticipated that some confusion would result, until motorists became acquainted with the change in movement, but we did not anticipate quite so much criticism.

The peak afternoon traffic (by far the heaviest) occurred from about 4:30 p. m. to 6:30 p. m. At 4 o'clock, the afternoon of the second day we were prepared to observe the operation of the signals to try and ascertain where our calculations were at fault, so the necessary adjustments could be made. About 4:30 p. m. the traffic officer, evidently feeling that the signals would not adequately handle the peak traffic, started to use manual control. At about 5:30 p. m. long streams of vehicles were converging on the intersection from every street, traffic moved at a snail's pace and congestion was rampant.

Small Group Movement Most Efficient

There seemed to be three main reasons for this condition. First, the motorists were unaccustomed to the change in the movement of traffic; many of them had seen the signals for the first time. Then, it is a natural tendency on the part of any officer manually controlling traffic to hold the *green* light for stragglers and the seconds inefficiently used up in this manner only allow more vehicles to accumulate on the line of traffic which is stopped. This practice continues until it takes more and more time to move the various streams of traffic. Our experience shows that the most efficient way to move traffic is in relatively small groups, since the longer the line of cars the more time per car it takes to move the group. In other words, for purposes of illustration, to move six cars in line past a certain point will require probably a three-second car headway whereas, to move 12 cars in line past the same point would require a four-

second car headway; 48 seconds to move the twelve cars together, but only 36 seconds to move the same twelve in two groups of six each. Finally, the vehicles in flow No. 1 had to be kept back of a white line on the west side of the intersection which was far enough back to give the cars in flow No. 3 a fairly long sweep, so they could weave easier with the vehicles in flow No. 2. The correct place for the officer to stand was near this stop line, so he could blow his whistle in time enough to halt the traffic at the line. In order to operate the signals manually, he had to leave this post and go to the southeast corner, consequently he could not adequately control this important stream of traffic and the vehicles were stopping quite a distance east of the stop line thus interfering with the movement of traffic in flow No. 3 making it difficult for this traffic to merge with flow No. 2. This caused numerous collisions and seriously delayed the movement of traffic.

Experiments With Three Forms of Control

Convinced that the automatic operation of the signals was the most efficient manner of controlling this intersection, but wishing to prove our contention by analyzing the movement of traffic under various methods, the next afternoon with the co-operation of the traffic officer we experimented with each of the three forms of control: automatic, manual with signals,. and manual with semaphore in accordance with former practices.

The signals were left on automatic control and the officer instructed to take his post where he could stop the eastbound traffic. Volume counts made during each wave of traffic, showed that during the 25 seconds of *green* per cycle allotted for flow No. 3 we were passing on the average, 36 cars with a headway for the stream of seven-tenths of a second; during the 22 seconds allotted for flow No. 1 an average of 29 vehicles passed with a headway of seventy-five hundredths of a second for the stream.

At 5:30 when the traffic was usually at its peak the officer was instructed to operate the signals by manual control. Up to this time traffic was moving without any congestion and in no case were more than four cars left behind on any stream of traffic when the red light appeared. The officer was surprised at the smooth flow and was amazed when he realized that it was the time for the peak volume.

Under manual control the traffic began to back up and more congestion became apparent. Studies made under this control showed the following results:

Girard Ave. Flow No. 1	*Main Drive Flow No.* 3
27 cars in 35 seconds	30 cars in 30 seconds
34 cars in 45 seconds	37 cars in 33 seconds
44 cars in 65 seconds	42 cars in 44 seconds
48 cars in 67 seconds	47 cars in 52 seconds
Average headway— 1.4 seconds	Average headway— 1.0 seconds

These figures indicated that the officer was continually increasing the length of the cycle in order to take care of the time lost waiting for stragglers; each time he had more cars in line to get through the intersection. It will also be noted that the headways increased over those shown under automatic control.

After a short time the traffic signals were turned off and the officer controlled traffic by a semaphore under the old method of moving traffic as shown in Fig. 2. Volume counts and time checks showed the following results:

Girard Ave. Flow No. 1	*Main Drive Flow No.* 3
38 cars in 50 seconds	44 cars in 42 seconds
43 cars in 65 seconds	50 cars in 45 seconds
51 cars in 80 seconds	48 cars in 46 seconds
Average headway— 1.48 seconds	Average headway— 0.93 seconds

Under these conditions the officer was continuing to use rather long cycles and whereas the headways on Girard Avenue were increasing those on the Main Drive decreased. This was due to the fact, as stated before, that the Girard Avenue traffic was being delayed through the congestion at point "B," whereas the Main Drive traffic could flow without interference from the westbound Girard Avenue traffic.

The following afternoon the signals were left on automatic control and at no time, even during the period of peak flow, was any congestion or delay noted. Orders were issued that the signals should never be operated under manual control, except during parades or other unusual occasions and in winter when snow or ice interfered with the normal movement of traffic.

This installation has been working satisfactorily for the past seven months, not one complaint has been received since the investigation was made and the traffic officers assigned to this intersection are pleased with the installation, not only because it controls traffic more efficiently, but also because it makes the job less hazardous.

▼

Three Short Statements on Highway Safety

Professor Robert L. Morrison, at the recent convention of the National Paving Brick Association: Mr. Chairman and Gentlemen: Aside from the matter of highway safety, I am quite convinced that my own personal safety can best be insured by being extremely brief. I have a perfectly swell two-hour speech in my system, but you are going to be spared from hearing it. I shall confine my remarks, with the Chairman's permission, to three short statements.

The first is that every single day there is an average of more than one hundred people killed in traffic accidents in this country; somewhere between three thousand and four thousand are injured, and, at a conservative estimate, the cost of these accidents every single day would pay for one hundred miles of brick pavement.

The second statement is that this condition is getting worse all the time. In 1935 there were fewer cars registered than there were in 1930, but there were nearly twenty-five per cent more deaths—a decrease in cars and presumably a decrease in mileage (I did not look up gasoline statistics), and a twenty-five per cent increase in deaths, seven thousand to be exact.

The third statement is that if the parents of children under ten years old would make those children stop running out between parked cars, if children between eleven and sixteen years old would stop roller skating and riding bicycles on the pavement and hitching on trucks, if persons between seventeen and around forty years of age would stop getting liquored up and driving sixty to one hundred miles an hour after midnight, and if the darned old fools my age and older—this is the worst of all—would stop wandering across the streets between the intersections after dark, our problem would practically disappear.

COMPARATIVE INFORMATION ON ROAD-BUILDING EQUIPMENT

THIS is a continuation of the tables published in the January issue of ROADS & STREETS. These tables will be continued in subsequent issues. As stated in the January issue, they are not to be considered as a complete specification material. We ask that the tables be used more as guides in discussions than for selecting equipment. Manufacturers of equipment should be contacted in cases where purchase of new equipment is involved. New models and improvements to older units occur constantly so that what is listed here may not be the latest at the time purchase is contemplated.

Contractors' pressure diaphragm and displacement pumps as well as varied nonstandardized diaphragm and displacement pumps will appear in a subsequent issue. The larger and stationary types of centrifugal pumps were omitted because they are not included under the designation "Contractors' Pumps." The included instructions for selecting pump sizes contains a statement that friction head should be increased by 25 per cent if the pipes are old or rough inside. Authority for this is Table I, page 119, May, 1936, WATER WORKS AND SEWERAGE. The capacity tables for various size pumps are followed by manufacturers who make that size, along with other information.

ARC WELDERS

Manufacturer	Amperage of Generator	Range of Welding Current	Size of Electrode, In.	Make of Engine	H.P. of Engine	Make of Generator	R.P.M of Welding Speed	Weight Lb.
J. D. Adams Co.	200	200	3/32 1/4	Hercules	33	Adams	1750	2800
	300	300	1/8 5/32	Hercules	46	Adams	1750	3475
Harnischfeger Corp.	300	90/375	1/8 5/32	Ford or Waukesha	60	Hansen	1750	3400
Hercules Steel Products	200	200/500	1/8 1/2	Any Truck Motor	46	Any make	1500	700
	500	200/500	1/8 1/2	Any Truck Motor	46	Any make	1500	1200
Hobart Bros.	200	40/300	*	Chrysler	43	Hobart	1750	1900
	300	50/400	*	Chrysler	43	Hobart	1750	2100
	400	60/600	*	Chrysler	65	Hobart	1750	3200
	500	70/800	*	Chrysler	75	Hobart	1750	4000
Lincoln Electric Co.	200	60/250	3/32 1/4	Buda	43	Lincoln	1400	2180
	200	60/250	3/32 1/4	Waukesha	27	Lincoln	1400	1080
	300	90/375	3/32 5/32	Buda	62	Lincoln	1400	2375
	400	120/500	3/32 5/32	Hercules	63	Lincoln	1400	2580
Schramm, Inc.	100 to 1000	100/1000	*	Ford or Buda	10 to 125	Gen. Electric	1750	....
Westinghouse Elec. & Mfg. Co.	200	60/250	3/32 1/4	Chrysler	38	Westinghouse	1500	2100
	300	90/375	1/8 5/32	Chrysler	41	Westinghouse	1500	2300
	400	120/150	5/32 3/8	Chrysler	66	Westinghouse	1500	2865
Universal Power Corp.	200	60/250	3/32 1/4	Chrysler	40	Universal	1750	2200
	300	90/375	1/8 5/32	Chrysler	50	Universal	1750	2700
	400	120/500	1/8 3/8	Chrysler	70	Universal	1750	3200
"USL" Owen-Dyneto Corp.	300	50/300	1/8 5/32	Chrysler	40	"USL"	1750	2300

*Electrode sizes not given because sizes usable with any machine of given capacity depend to some extent on operator and the degree of continuity of operation.

SIZES AND TYPES OF BUCKETS GENERALLY USED IN CONSTRUCTION ROADS AND STREETS FIELD

Dragline buckets are built in three standard types, viz.: for light digging, for general excavation, and for rock or difficult work—and dimensions and weights vary to meet demands of particular jobs. Capacities given are approximate.

Manufacturer	Type	Capacity in Cu. Yds. Light Duty	General Use	Heavy Duty
Bay City Shovels	Dragline	3/8 to 3/4	3/8 to 3/4	3/4
Blaw Knox Co.	Clamshell	1/2 to 2	1/2 to 2	5/8 to 2 1/2
Bucyrus Erie Co.	Dragline	3/8 to 10	3/8 to 12	3/8 to 10
Erie Steel Const. Co.	Clamshell	1/4 to 1 1/2	3/8 to 3	3/8 to 8
	Dragline	3/8 to 4	3/8 to 4	3/8 to 4
Geo. Haiss Mfg. Co.	Clamshell	3/8 to 2	3/8 to 2	3/8 to 2
Harnischfeger Corp. (a)	Dragline	3/8 to 4	3/8 to 4	3/8 to 4
Industrial Brown Hoist	Clamshell	3/8 to 2	3/8 to 3	3/8 to 3
Owen Bucket Co.	Clamshell	3/8 to 2	1/4 to 2	1/2 to 3
Page Engineering Co.	Dragline	3/8 to 15	3/8 to 15	3/8 to 15
Sauerman Bros.	Drag Scraper	1/4 to 5	1/2 to 14	1/2 to 15
	Slack Line	1/2 to 3/4	1/2 to 1 1/2	1 to 3 1/2
Wellman Engineering Co. (b)	Dragline	3/8 to 15	3/8 to 15	3/8 to 15
	Clamshell	3/8 to 3	3/8 to 3	3/8 to 3

(a) Also builds light weight buckets of aluminum alloy.
(b) Builds any type or size bucket.

LOADERS: Belt, Bucket and Chain

Manufacturer	Model	Rated Output Cu. Yds. per Min.	Type Belt, Chain, Bucket	Make of Engine	Engine H.P.	Type Mounting Wheel, Crawler
Barber-Greene Co.	Model 82	2 to 3	Bucket	Buda	33	Crawler
	Model 28	¾ to 1	Bucket	LeRoi	20	Wheel
Burch Corporation	Truck Loader	1 to 2	Belt	LeRoi	8	Wheel
Conant Machinery Co.	.....	2	Bucket	LeRoi	5 to 8	Wheel
Godfrey Conveyor Co.	Model TB1	¾	Belt	Optional	3 to 7½	Wheel
	Model TB2	1¼	Belt	Optional	3 to 7½	Wheel
Geo. Haiss Manufacturing Co.	Model 75	3 to 4	Chain and Bucket	Waukesha	30	Crawler
	Model 27	2 to 3	Chain and Bucket	Waukesha	46	Crawler
	Model 80	3 to 5	Chain and Bucket	Waukesha	60	Crawler
	Model 135	5 to 8	Chain and Bucket	Waukesha	65	Crawler
Joy Manufacturing Co.	Snow	10 to 20[1]	Chain	White	82 and 87[2]	Wheel
Link Belt Co.	Grizzly	1¾	Bucket	Buda	30	Crawler
	C. F. 18	1½	Belt	LeRoi	..	Wheel
	C. F. 24	2	Belt	LeRoi	..	Wheel
Nelson Iron Works	Model Q7	2	Chain and Bucket	I. H. C.	35	Crawler
	Model L4	2 to 3	Chain and Bucket	Hercules	30	Crawler and Wheel

[1]Capacity Snow. [2]2 motors, one propelling, one for conveying mechanism.

ELEVATING GRADERS

Manufacturer	Type	Belt Width In.	Length of Carrier	How Driven Bull Wheel, Power Takeoff or Engine	Type Control Manual or Power	Draw Bar H.P. Recommended	Weight Lbs.
J. D. Adams Company	No. 11	48	16'9", 19', 22', 25'	Engine*	Power	60 or more	17,410
	No. 12	42	16'9", 19', 22', 25'	Engine †	Power	60 or more	15,680
Austin Western Road Machy. Co.	3 wheel	48	19', 22', 25'	Engine	.....	75 or more	17,300
	Contr's Special	42	16', 19', 22'	Engine	Power	60 or more	15,150
Caterpillar Tractor Co.	No. 48	48	19', 22', 25'	Engine*	Power	60 or more	18,670
	No. 48	48	19', 22', 25'	Engine†	Power	60 or more	18,210
	No. 48	48	19', 22', 25'	Power Takeoff	Power	60 or more	17,800
	No. 42	..	19', 22'	Engine*	Power	50 or more	16,670
	No. 42	..	19', 22'	Engine†	Power	50 or more	16,310
*Diesel. †Gasoline.	No. 42	..	19', 22'	Power Takeoff	Power	50 or more	15,540

CONTRACTOR'S SELF-PRIMING CENTRIFUGAL PUMPS

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions.

2-Inch Model 7M—Capacity 7,000 G.P.H.

2-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	140	...	..	..
25 ft.	135	115	85	..
30 ft.	130	110	83	65
40 ft.	110	95	77	60
50 ft.	65	60	55	48
60 ft.	5	5	5	5
70 ft.	...	...	..	..

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Briggs & Stratton	2	225
C. H. & E. Mfg. Co.	Briggs & Stratton	2	175
The Gorman Rupp Co.	Briggs & Stratton	2	128
The Gorman Rupp Co.	Briggs & Stratton	2	220
The Gorman Rupp Co.	Stover	2½	270
Jaeger Machine Co.	Stover	2½	175
Chain Belt Co.	Stover	2½	230
Marlow Pumps	Cushman	1½	96
Novo Engine Co.	Novo	2	250
Sterling Machinery Corp.	Briggs & Stratton	2	180

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions.

2-Inch Model 10M—Capacity 10,000 G.P.H.

2-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	...	...	...	..
25 ft.	185	166	...	..
30 ft.	177	160	105	75
40 ft.	155	140	100	70
50 ft.	125	115	90	65
60 ft.	85	75	70	55
70 ft.	20	20	15	15

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Wisconsin	4	400
Ralph B. Carter Co.	Stover or Lauson	4	270
C. H. & E. Mfg. Co.	Wisconsin	4	420
Domestic Eng. & Pump Co.	Wisconsin	4	410
The Gorman Rupp Co.	Wisconsin	4	290
Jaeger Machine Co.	Wisconsin	4	265
Chain Belt Co.	Wisconsin	4	330
Marlow Pumps	Stover	2½	290
Marlow Pumps	Wisconsin	4	310
Novo Engine Co.	Novo	4	360
Sterling Machinery Corp.	Wisconsin	4	305

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions.

3-Inch Model 15M—Capacity 15,000 G.P.H.

3-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	280	250	...	...
25 ft.	275	245	170	...
30 ft.	265	235	165	130
40 ft.	245	215	160	125
50 ft.	210	185	145	120
60 ft.	160	135	125	105
70 ft.	85	65	65	60
80 ft.	...	...	...	...

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Wisconsin	5	485
Ralph B. Carter Co.	Stover or Wisconsin	6	490
C. H. & E. Mfg. Co.	Wisconsin	4½	435
Gorman-Rupp Co.	Wisconsin	5	300
Jaeger Machine Co.	Wisconsin	5	290
Chain Belt Co.	Wisconsin	4½	275
Marlow Pumps	Cushman	2½	106
Novo Engine Co.	Novo	5	485
Sterling Machinery Corp.	Wisconsin	5	310

CONTRACTOR'S SELF-PRIMING CENTRIFUGAL PUMPS—*Continued*

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions for this size pump.

Model 20M—20,000 G.P.H.

3-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	370	...	...	...
25 ft.	355	325	235	...
30 ft.	340	310	230	165
40 ft.	300	270	215	160
50 ft.	255	230	190	145
60 ft.	190	170	150	120
70 ft.	120	105	95	80
80 ft.	40	40	40	40

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Wisconsin	6	495
Ralph B. Carter Co.	Stover or Wisconsin	6	520
C. H. & E. Mfg. Co.	Wisconsin	6	585
Gorman-Rupp Co.	Wisconsin	7 to 8	410
Jaeger Machine Co.	Wisconsin	6	385
Chain Belt Co.	Wisconsin	6	420
Marlow Pump	Wisconsin	6	510
Novo Engine Co.	Novo	7	565
Sterling Machinery Corp.	Wisconsin	6	470
Domestic Eng. & Pump Co.	Wisconsin	6	595

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions for this size pump.

4-Inch Model 3M—Capacity 30,000 G.P.H.

4-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	535	500	...	...
25 ft.	530	490	350	...
30 ft.	520	485	345	250
40 ft.	500	460	330	245
50 ft.	465	430	320	235
60 ft.	425	385	300	225
70 ft.	365	325	275	205
80 ft.	285	250	215	165
90 ft.	135	115	105	95
100 ft.	...	...	...	...
110 ft.	...	...	...	...

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Hercules	12	1000
C. H. & E. Mfg. Co.	Wisconsin	12	725
Gorman-Rupp Co.	Wisconsin	12 to 15	540
Gorman-Rupp Co.	Hercules	12 to 15	595
Jaeger Machine Co.	Wisconsin	10 to 12	620
Chain Belt Co.	Wisconsin	10 to 15	680
Novo Engine Co.	Novo	9	565
Sterling Machinery Corp.	Wisconsin	10 to 12	625
Domestic Eng. & Pump Co.	Hercules	12	1070

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions for this size pump.

4-Inch Model 40M—Capacity 40,000 G.P.H.

4-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	...	...	...	...
25 ft.	750	665	...	...
30 ft.	745	660	475	355
40 ft.	725	645	465	350
50 ft.	690	620	455	345
60 ft.	645	585	435	335
70 ft.	585	535	410	315
80 ft.	500	465	365	280
90 ft.	405	375	300	220
100 ft.	275	250	195	145
110 ft.	75	65	50	40

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Hercules	25	1060
Ralph B. Carter Co.	Hercules-Continental.	20	1100
Domestic Eng. & Pump Co.	Waukesha	20	1700
Gorman-Rupp Co.	Hercules	25 to 30	945
Jaeger Machine Co.	Wisconsin	20 to 25	1130
Chain Belt Co.	Waukesha	20 to 25	1220
Marlow Pumps	Waukesha	25	1510
Novo Engine Co.	Novo	20	1080
Sterling Machinery Corp.	Waukesha	20 to 25	1125
C. H. & E. Mfg. Co.	Waukesha	25	1000

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions for this size pump.

6-Inch Model 75M—Capacity 75,000 G. P. H.

6-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	1350	1250	...	...
25 ft.	1325	1240	900	...
30 ft.	1290	1200	875	650
40 ft.	1200	1095	800	600
50 ft.	1025	910	675	500
60 ft.	725	625	475	350
70 ft.	275	225	190	150
80 ft.	...	...	...	...
90 ft.	...	...	...	...
100 ft.	...	...	...	...

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Hercules	25	1650
C. H. & E. Mfg. Co.	Waukesha	25	1300
Gorman-Rupp Co.	Hercules	25 to 30	1200
Jaeger Machine Co.	Wisconsin	20 to 25	1500
Chain Belt Co.	Waukesha	30 to 35	1750
Marlow Pumps	Waukesha	20 to 25	1950
Novo Engine Co.	Novo	20 to 25	1780
Sterling Machinery Corp.	Waukesha	20 to 25	1250

The following table has been adopted as a standard by the Contractors' Pump Manufacturers' Association and sets forth the performance requirements under average job conditions for this size pump.

6-Inch Model 90M—Capacity 90,000 G.P.H.

6-Inch Suction and Discharge

Following table gives capacity in gallons per minute.

Total head including friction	Height of pump above water 5 ft.	10 ft.	20 ft.	25 ft.
20 ft.	1680	...	...	...
25 ft.	1650	1500	...	...
30 ft.	1625	1480	1050	790
40 ft.	1550	1430	1020	780
50 ft.	1450	1350	970	735
60 ft.	1325	1225	900	690
70 ft.	1175	1050	775	610
80 ft.	925	800	600	490
90 ft.	525	450	365	300
100 ft.	100	100	100	100

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Barnes Mfg. Co.	Hercules	35	1850
Ralph B. Carter Co.	LeRoi-Carterford	60	2400
C. H. & E. Mfg. Co.	LeRoi	45	1450
Gorman-Rupp Co.	Hercules	35 to 40	1540
Jaeger Machine Co.	Wisconsin	30 to 35	1760
Chain Belt Co.	Waukesha	30 to 35	1920
Marlow Pumps	LeRoi	40	2200
Novo Engine Co.	Novo	30 to 35	2000
Sterling Machinery Corp.	Waukesha	30 to 35	1430
Domestic Eng. & Pump Co.	LeRoi	30	2100

*Weights given vary with type of mounting.

Large Capacity Self-Priming Centrifugal Pumps

For big volume heavy duty work—well points, large excavations, sewers, septic tanks, bridge jobs, stripping mines, sand and gravel plants, etc.

8 in. Suction and Discharge 125M Capacity 125,000 G. P. H.

Manufacturer	Make of engine.	Engine H.P.	Weight, lb.*
Ralph B. Carter Co.	Hercules-Carterford	60	2700
C. H. & E. Mfg. Co.	Waukesha	60	2100
Chain Belt Co.	Waukesha	50 to 60	2050
Domestic Eng. & Pump Co.	Hercules-Carterford	60	2700
Domestic Eng. & Pump Co.	Continental	40 to 50	3100
Gorman-Rupp Co.	Hercules	50 to 60	2050
Jaeger Machine Co.	Wisconsin	40 to 50	1825
Jaeger Machine Co.	Wisconsin**	40 to 50	2500
Marlow Pumps	Waukesha	60	2400
Sterling Machinery Corp.	Waukesha	50 to 60	2160

*Weights vary with mounting.
**Diesel or oil engines can be supplied.

Note.—Comparative information of contractors diaphragm lift and force and plunger type—and information covering pressure displacement pumps will follow in a future issue of ROADS AND STREETS.

CONTRACTORS' DIAPHRAGM PUMPS

The following table has been adopted by the Associated General Contractors Association as standard ratings for diaphragm pumps, and sets forth the performance requirements under average job conditions for this size pump. Each manufacturer listed guarantees a capacity of 10 per cent greater than shown.

No. 3 Single Open Top A.G.C. Ratings

15 Ft. 3" Suction Hose 10-ft. Lift Capacity 4,000 G.P.H.
30 Ft. 3" Suction Hose 20-ft. Lift Capacity 2,000 G.P.H.

Manufacturer	Make of Engine	H.P. Engine	How Mounted	Weight, Lb.*
Barnes Mfg. Co.	Stover	2-2½	Truck	750
Ralph B. Carter Co.	Stover	2	4 wheel truck	560
C. H. & E. Mfg. Co.	Stover	2	2 wheels	700
Chain Belt Co.	Stover	1½	2 wheels	525
Domestic Engine & Pump Co.	Domestic	1½	2 wheels*	700
Humphreys Mfg. Co.	Stover	2	Truck	900
Jaeger Machine Co.§	Stover	2	2 wheel truck	750
Marlow Pumps	Stover	2	4 wheels	620

†With 4-wheel mounting, weight 750 lb.
*Weights vary with type mounting employed.
§Convertible to either open or closed discharge.

No. 4 Single Open Top A.G.C. Ratings

15 Ft. 4" Suction Hose 10-ft. Lift Capacity 8,000 G.P.H.
30 Ft. 4" Suction Hose 20-ft. Lift Capacity 4,000 G.P.H.

Manufacturer	Make of Engine	H.P. Engine	How Mounted	Weight, Lb.
Barnes Mfg. Co.	Stover	2-2½	Truck	850
Ralph B. Carter Co.	Stover	2	4 wheels truck	560
C. H. & E. Mfg. Co.†	Stover	2	4 wheel truck*	800
Chain Belt Co.	Stover	2	Trailer	750
Domestic Engine & Pump Co.	Domestic	2	2 wheels	955
Domestic Engine & Pump Co.	Wisconsin	3-4	2 wheels	1075
Humphreys Mfg. Co.	Stover	2	Truck	1000
Jaeger Machine Co.§	Stover	2½	4 wheel truck	950
Jaeger Machine Co.§	Wisconsin	6	4 wheel truck	1150
Marlow Pumps	Stover	2	Truck	900

†Lift or force attachments can be furnished.
*Also spring mounted. Weight 750 lb.
§Convertible to closed discharge.

No. 4 Double Open Top A.G.C. Ratings

15 Ft. 4" Suction Hose 10-ft. Lift Capacity 12,000 G.P.H.
30 Ft. 4" Suction Hose 20-ft. Lift Capacity 7,000 G.P.H.

Manufacturer	Make of Engine	H.P. Engine	How Mounted	Weight, Lb.
Ralph B. Carter Co.	Stover	5	4 wheel truck	1400
C. H. & E. Mfg. Co.	Stover	4	4 wheel truck	1500
Chain Belt Co.	Stover	5	2 wheel trailer	1250
Domestic Engine & Pump Co.	Stover or LeRoi	6-8	4 wheel truck	1580
Domestic Engine & Pump Co.	Herc. or Cont'l	10-12	4 wheel truck	1700
Humphreys Mfg. Co.	LeRoi	5	4 wheel truck	1700
Jaeger Machine Co.§	Stover	3½	4 wheel truck	1650
Jaeger Machine Co.§	Wisconsin	6	4 wheel truck	1700
Marlow Pumps	LeRoi	4	4 wheel truck	140
Novo Engine Co.	Novo	4-5	4 wheel truck	1375

§Convertible to closed top.

Non-standardized diaphragm pumps will appear next month.

ADD TO **MOTOR GRADERS** IN **JANUARY** ISSUE

Footnote: Motor graders listed below have speeds higher than fourth as listed.

Mfr.	Line No.	Roadspeeds at Rated Engine R.P.M Fifth	Sixth
J. D. Adams Co.	1	15.0 m.p.h.	.....
	2	15.0 m.p.h.	.....
Austin-Western Road Mchy. Co.	1	8.1 m.p.h.	13.0 m.p.h.
	2	8.1 m.p.h.	13.0 m.p.h.
	3	8.1 m.p.h.	13.0 m.p.h.
	4	8.1 m.p.h.	13.0 m.p.h.
Huber Mfg. Co.	1	11.3 m.p.h.	.....
	2	11.3 m.p.h.	.....

▼

Short Sightedness, We Think

The Petroleum Industries committee, which has been waging a campaign throughout the United States to reduce gasoline taxes in the interest of the large gasoline and oil companies, just issued a bulletin which contends that:

> The average automobile in the United States pays $38.35 in gasoline taxes, state and federal.
>
> The average automobile throughout the United States pays a total including gasoline, motor vehicle license, and in some states weight and personal property taxes, of $50.35.

Because automobiles travel much farther each year than they did five years ago, the Petroleum Institute estimates that the average car uses 700 gallons of gasoline instead of 600 gallons per year at that time. This, the Institute points out, increases the gasoline tax revenue throughout the United States by $150,000,000 annually.

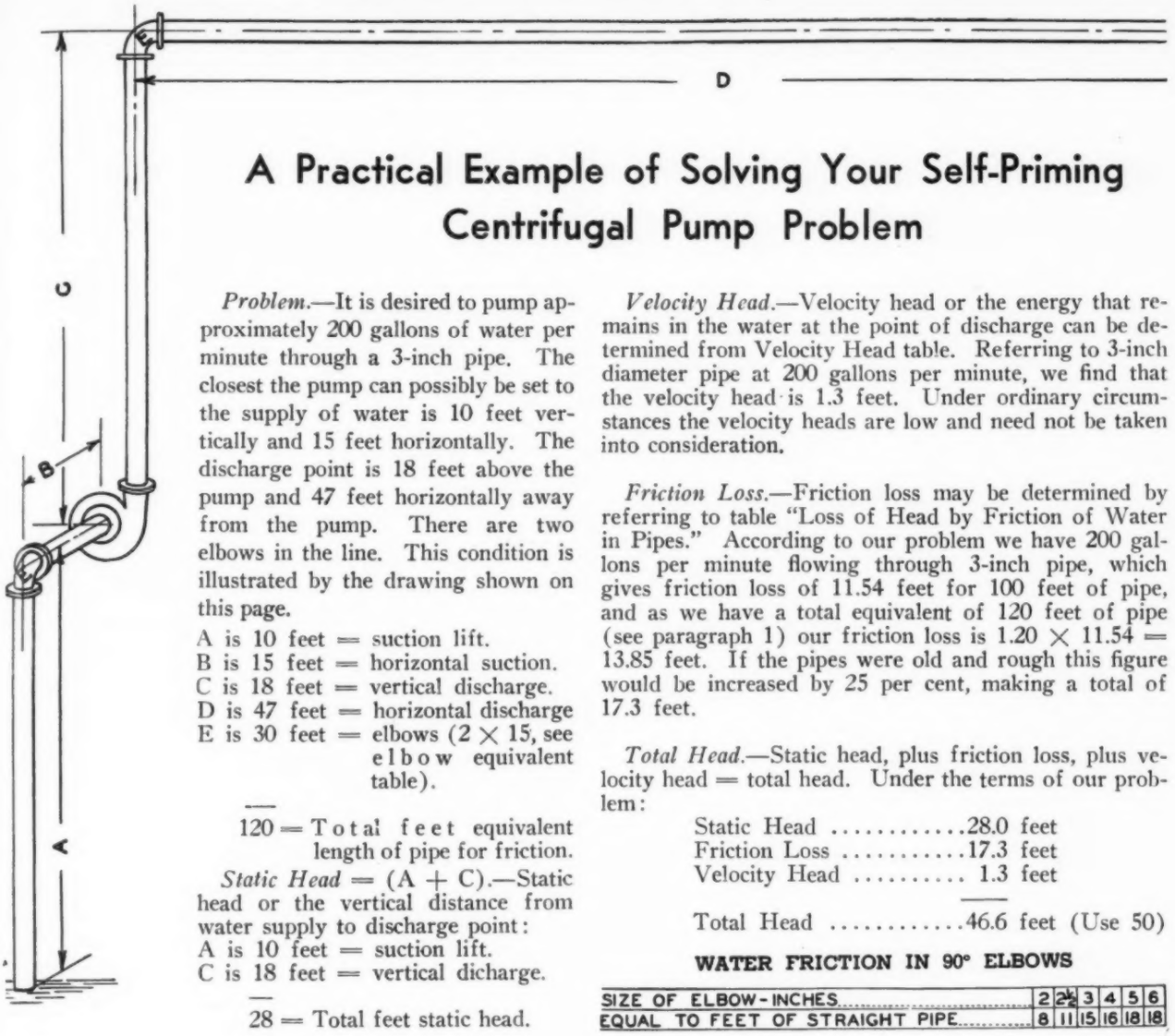
What the Petroleum Institute fails to point out, however, is that the reason why automobiles travel farther, use more gasoline and pay more gas taxes, is because the gasoline taxes of the past have been used to build more and better roads on which to travel.

▼

Gasoline Tax Diversion

"The enactment of state laws diverting gasoline and other motor vehicle taxes from highway purposes to other uses can only be construed by the National Congress as a clear indication that those states are not interested in the continuation of a program of highwa construction and consequently do not care to continue to receive the benefits of Federal-aid for roads."—Senator Hayden to C. M. Upham, recently.

We urge you to bring this to the attention of your state legislators, where they are in session. *It is very important!*



A Practical Example of Solving Your Self-Priming Centrifugal Pump Problem

Problem.—It is desired to pump approximately 200 gallons of water per minute through a 3-inch pipe. The closest the pump can possibly be set to the supply of water is 10 feet vertically and 15 feet horizontally. The discharge point is 18 feet above the pump and 47 feet horizontally away from the pump. There are two elbows in the line. This condition is illustrated by the drawing shown on this page.

A is 10 feet = suction lift.
B is 15 feet = horizontal suction.
C is 18 feet = vertical discharge.
D is 47 feet = horizontal discharge
E is 30 feet = elbows (2×15, see elbow equivalent table).

120 = Total feet equivalent length of pipe for friction.

Static Head = (A + C).—Static head or the vertical distance from water supply to discharge point:
A is 10 feet = suction lift.
C is 18 feet = vertical dicharge.

28 = Total feet static head.

Velocity Head.—Velocity head or the energy that remains in the water at the point of discharge can be determined from Velocity Head table. Referring to 3-inch diameter pipe at 200 gallons per minute, we find that the velocity head is 1.3 feet. Under ordinary circumstances the velocity heads are low and need not be taken into consideration.

Friction Loss.—Friction loss may be determined by referring to table "Loss of Head by Friction of Water in Pipes." According to our problem we have 200 gallons per minute flowing through 3-inch pipe, which gives friction loss of 11.54 feet for 100 feet of pipe, and as we have a total equivalent of 120 feet of pipe (see paragraph 1) our friction loss is $1.20 \times 11.54 = 13.85$ feet. If the pipes were old and rough this figure would be increased by 25 per cent, making a total of 17.3 feet.

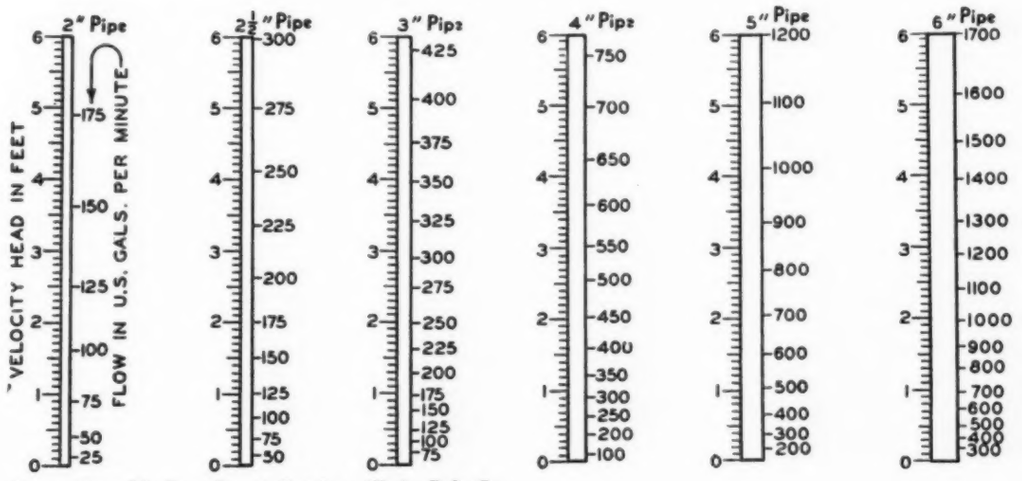
Total Head.—Static head, plus friction loss, plus velocity head = total head. Under the terms of our problem:

Static Head	28.0 feet
Friction Loss	17.3 feet
Velocity Head	1.3 feet
Total Head	46.6 feet (Use 50)

WATER FRICTION IN 90° ELBOWS

SIZE OF ELBOW - INCHES	2	2½	3	4	5	6
EQUAL TO FEET OF STRAIGHT PIPE	8	11	15	16	18	18

Velocity Head in Pipes



From Page 22, Rex Pump Catalog, Chain Belt Co.

LOSS OF HEAD BY FRICTION OF WATER IN PIPES

Giving the Velocity in Feet per Second, the Friction Head in Feet, and Friction Loss in Pounds, Pressure per Square Inch for each 100 Feet in Length of Pipe, for Different Sizes of Clean Iron Pipe Discharging Different Quantities per Minute

Gals. per Min.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Velocity in Ft. per Sec.	Friction Head in Ft.	Friction Loss in Lbs. per sq. in.	Gals. per Min.
	¾ INCH PIPE			1 INCH PIPE			1¼ INCH PIPE			1½ INCH PIPE			2 INCH PIPE			2½ INCH PIPE			3 INCH PIPE			3½ INCH PIPE			
5	3.64	7.59	3.3	2.04	1.93	0.84	1.3	0.71	0.31	0.91	0.27	0.12	0.49	0.092	0.04	0.244	0.046	0.02							5
10	7.28	29.90	13.0	4.08	10.26	3.16	2.6	2.41	1.05	1.82	1.08	0.47	0.98	0.277	0.12	0.656	0.092	0.04	0.448	0.046	0.02				10
15	10.92	66.01	28.7	6.12	16.05	6.98	3.9	5.47	2.38	2.73	2.23	0.97	1.47	0.577	0.25	0.985	0.185	0.08	0.672	0.092	0.04	0.498	0.046	0.02	15
20	14.56	115.92	50.4	8.16	28.29	12.30	5.2	9.36	4.07	3.64	3.81	1.66	2.04	0.97	0.42	1.315	0.323	0.14	0.896	0.138	0.06	0.664	0.069	0.03	20
25	18.2	180.00	78.0	10.20	43.70	19.0	6.5	14.72	6.4	4.55	5.02	2.62	2.6	1.43	0.62	1.645	0.485	0.21	1.12	0.231	0.10	0.83	0.092	0.04	25
30	4 INCH PIPE			12.24	63.25	27.5	7.8	21.04	9.15	5.46	8.62	3.75	3.03	2.09	0.91	1.97	0.693	0.30	1.345	0.30	0.13	0.996	0.138	0.06	30
35				12.28	85.10	37.0	9.1	28.52	12.4	6.37	11.61	5.05	3.54	2.76	1.22	2.29	0.92	0.40	1.569	0.393	0.17	1.163	0.208	0.09	35
40	1.04	0.1383	0.06	16.32	110.40	48.0	10.4	37.03	16.1	7.28	14.99	6.52	4.05	3.68	1.60	2.62	1.19	0.53	1.79	0.53	0.23	1.329	0.256	0.11	40
45	1.17	0.1615	0.07	5 INCH PIPE			11.7	46.46	20.2	8.19	18.74	8.15	4.56	4.60	1.99	2.95	1.49	0.66	2.016	0.647	0.28	1.494	0.323	0.14	45
50	1.3	2.08	0.09				13.	57.27	24.9	9.1	23.00	10.0	5.1	5.61	2.44	3.3	1.86	0.81	2.24	0.80	0.35	1.66	0.393	0.17	50
60	1.56	0.3	0.13	0.88	0.1156	0.05	15.6	85.50	37.0	10.92	32.95	14.25	6.12	8.88	3.50	3.95	2.7	1.17	2.688	1.155	0.50	1.992	0.555	0.24	60
70	1.82	0.439	0.19	1.03	0.162	0.07	18.2	114.00	49.3	12.74	44.6	19.3	7.14	11.09	4.80	4.6	3.46	1.50	3.136	1.385	0.60	2.324	0.879	0.38	70
75	1.95	0.485	0.21	1.2	0.174	0.075	19.5	129.00	56.1	13.65	51.52	22.4	7.7	12.21	5.32	4.93	4.14	1.80	3.360	1.70	0.75	2.490	0.913	0.395	75
80	2.08	0.581	0.23	1.28	0.185	0.08				14.56	58.45	25.3	8.16	14.55	6.30	5.26	4.62	2.00	3.584	2.08	0.90	2.656	0.948	0.41	80
90	2.34	0.6	0.26	1.44	0.28	0.09	6 INCH PIPE			16.38	81.5	35.25	9.18	18.02	7.80	5.91	5.96	2.58	4.032	2.54	1.10	2.988	1.247	0.54	90
100	2.60	0.763	0.33	1.6	0.277	0.12	1.14	0.115	0.05		89.70	39.0	10.2	21.75	9.46	6.5	7.36	3.20	4.480	3.01	1.31	3.320	1.478	0.64	100
125	3.25	1.13	0.49	2.	0.393	0.17	1.42	0.161	0.07	7 INCH PIPE			12.8	34.27	14.9	8.13	11.24	4.89	5.6	4.57	1.99	4.15	2.219	0.96	125
150	3.8	1.59	0.69	2.4	0.578	0.25	1.71	0.231	0.10	1.2	0.0924	0.04	15.3	48.76	21.2	9.8	16.10	7.00	6.8	6.55	2.85	4.98	3.12	1.35	150
175	4.45	2.146	0.93	2.8	0.785	0.34	2.	0.302	0.13	1.38	0.115	0.05	8 INCH PIPE			11.43	21.75	9.46	7.92	8.85	3.85	5.81	4.205	1.82	175
185	4.7	2.484	1.075	2.96	0.84	0.363	2.11	0.36	0.1559	1.55	0.13	0.0562				11.84	24.5	10.61	8.34	9.94	4.3	6.14	4.62	2.00	185
200	5.1	2.82	1.22	3.2	0.972	0.42	2.28	0.393	0.17	1.7	0.162	0.07				13.06	28.68	12.47	9.04	11.56	5.02	6.64	5.50	2.38	200
250	6.4	4.37	1.89	4.	1.504	0.65	2.8	0.601	0.26	2.1	0.2775	0.12	1.6	0.162	0.07	9 INCH PIPE			11.28	17.86	7.76	8.30	8.55	3.70	250
265	6.79	4.645	2.09	4.24	1.69	0.731	3.03	0.70	0.303	2.23	0.31	0.134	1.698	0.175	0.0757				12.4	20.09	8.72	8.8	9.6	4.15	265
300	7.6	6.15	2.66	4.8	2.15	0.93	3.4	0.85	0.37	2.4	0.393	0.17	1.9	0.208	0.09	1.5	0.115	0.05	13.52	25.76	11.2	9.96	11.63	5.04	300
350	8.9	8.44	3.65	5.6	2.914	1.26	3.9	1.15	0.50	2.94	0.531	0.23	2.2	0.2775	0.12	1.75	0.1618	0.07	10 INCH PIPE			11.62	16.4	7.10	350
370	9.41	9.13	4.04	5.92	3.197	1.382	4.22	1.33	0.576	3.1	0.59	0.255	2.37	0.306	0.1324	1.85	0.178	0.077	2.	0.204	0.09	12.28	18.13	7.85	370
400	10.1	10.92	4.71	6.5	3.72	1.61	4.5	1.50	0.65	3.36	0.693	0.30	2.6	0.37	0.16	2.	0.208	0.09	2.	0.416	0.18	13.28	21.36	9.25	400
450	11.4	13.88	6.01	7.3	4.62	2.00	5.05	1.87	0.81	3.96	0.855	0.37	2.92	0.462	0.20	2.25	0.2545	0.11	1.8	0.1618	0.07	12 INCH PIPE			450
480	12.16	14.34	6.21	7.68	5.06	2.192	5.49	2.16	0.935	4.03	0.96	0.415	3.07	0.498	0.2155	2.4	0.3	0.13	1.92	0.1816	0.0785				480
500	12.7	17.16	7.43	8.1	5.55	2.40	5.6	2.22	0.96	4.2	1.04	0.45	3.2	0.5785	0.25	2.5	0.324	0.14	2.	0.204	0.09	1.4	0.0925	0.04	500
750	14 INCH PIPE			12.15	11.28	4.875	8.4	5.11	2.21	6.3	2.34	1.03	4.8	1.224	0.53	3.75	0.6945	0.30	3.	0.416	0.18	2.1	0.1848	0.08	750
1000	2.224	0.1632	0.062				11.3	8.98	3.88	8.4	41.6	1.80	6.4	2.17	0.94	5.	1.224	0.53	4.	0.74	0.32	2.8	0.304	0.13	1000
1100	2.444	0.18	0.078	15 INCH PIPE			12.57	10.90	4.715	9.25	5.08	2.20	7.04	2.64	1.142	5.5	1.50	0.649	4.4	0.88	0.381	3.08	0.375	0.162	1100
1250	2.78	0.22	0.0952				14.1	13.86	6.00	10.5	6.60	2.85	8.0	3.378	1.46	6.25	1.895	0.82	5.	1.132	0.49	3.5	0.462	0.20	1250
1500	3.336	0.306	0.135	2.7	0.22	0.0952	18 INCH PIPE			12.6	9.45	4.08	9.6	4.84	2.09	7.5	2.704	1.17	6.1	1.618	0.70	4.2	0.67	0.29	1500
2000	4.448	0.541	0.234	3.6	0.38	0.1645	2.74	0.195	0.0844	20 INCH PIPE			12.7	8.70	3.765				8.1	2.842	1.23	5.6	1.132	0.49	2000
2200	4.9	0.68	0.2913	3.96	0.455	0.197	3.18	0.26	0.1124				14.09	10.71	4.64				8.8	3.34	1.446	6.16	1.38	0.598	2200
2500	5.562	0.8365	0.362	4.5	0.575	0.248	3.254	0.295	0.1276				22 INCH PIPE						10.1	4.43	1.92	7.	1.78	0.77	2500
3000	6.674	1.19	0.515	5.4	0.79	0.342	4.11	0.405	0.175	3.308	0.25	0.108	2.973	0.18	0.078				12.1	6.30	2.725	8.4	2.567	1.11	3000
3300	7.34	1.45	0.6285	5.94	0.93	0.402	4.52	0.475	0.2056	3.64	0.294	0.127							13.2	7.50	3.24	9.24	3.08	1.333	3300

From Page 36, *Catalog* P36, *Jaeger Mfg. Co.*

By referring to the capacity chart of the 3-inch pump in the tables and selecting the column marked 10 feet suction lift because this corresponds to our problem, and following this we find that the 15M pump is capable of delivering 185 gallons of water per minute under total head of 50 feet, or we find that the 20M pump is capable of delivering 230 gallons per minute under a total head of 50 feet.

IMPORTANT

Please note the difference between 28 feet static head and 46.6 feet total head and bear in mind that all centrigugal pumps are rated on total head, and the average pump user thinks in terms of static head. The 3-inch 20M pump that we selected, if it had only a 28-foot head to work against, would have delivered 315 gallons of water per minute instead of 230 gallons per minute.

Resolutions Adopted by American Association of State Highway Officials

Maine, New Jersey, Montana and West Virginia were the only states not represented at the December meeting of the American Association of State Highway Officials. Resolutions adopted recommended that:

1.—In the event of further Federal relief appropriations, a substantial portion be made available to State Highway Departments through the Bureau of Public Roads;

2.—The Federal secondary road funds should be expended under supervision of the State Highway Departments;

3.—Economic surveys now in progress be used to determine secondary road system;

4.—Contractors on Federal Aid projects be permitted to employ skilled and intermediate labor directly, and revision of hour regulations to permit employee to earn reasonable annual income;

5.—The emblem used for marking Federal highways be copyrighted by the association;

6.—Regular Federal Aid funds be advanced to establish trust account revolving funds;

7.—Continuation of appropriations for co-operation with Central American countries in bridge and road construction;

8.—The Inter-American highway be endorsed.

▼

Constitutional Amendment in Pennsylvania Would Prevent Diversion

We have just received word that a Bill has been introduced in the Legislature in Pennsylvania which would prohibit the diversion of motor vehicle revenues. If this Bill passes it must then be put to referendum vote and again voted on in the Legislature before it becomes a law.

In most instances a constitutional amendment is a long process which emphasizes the importance of immediate action to preserve motor revenues exclusively for highways.

WPA Projects for Roadside Improvements

IN hundreds of localities throughout the Nation, crews of men are busily engaged in roadside improvement projects sponsored by local authorities and financed largely with Federal funds supplied through the Works Progress Administration.

Altogether there has been 2,424 WPA projects for roadside improvements, of which 742 were actively in operation at the last report and 1,682 were classed as completed and inactive. The estimated cost of all projects is $103,463,177. The estimated cost of the active projects is $80,493,866.

Statewide Roadside Project.—Some of the road improvement projects are statewide, as in Massachuetts, Pennsylvania and Arizona. Of these, the program in Massachusetts is the most extensive, with 55 projects, under the supervision of the Massachusetts Department of Public Works. Many hundreds of thousands of yards of sod, loam and gravel have been used to level off or build up the approaches to the roads and thousands of pounds of grass seeds were planted after this work had been done in the summer of 1936.

On a comparatively short stretch of road between Cambridge and Concord, more than 5,000 indigenous trees and shrubs were planted. Comparative plantings were made on roads throughout the state. These trees and shrubs, in addition to vines, bushes and seedlings were purchased from Massachusetts nurseries, through the Procurement Department of the United States Treasury, at prices ranging from 20 cents each for flowering dogwood to $6 each for certain rare oaks and other deciduous varieties of trees. These trees were interspersed with conifers to simulate the natural assortment of vegetation in each locality.

The transcontinental motorist going by the Southern route, will be one of the beneficiaries of a statewide roadside improvement program in Arizona. Among the roads to be improved are the main arteries of traffic through the Salt River valley—Tempe to Apache Junction on the Phoenix-Yuma highway, and Phoenix to Wickenburg on the Phoenix-Prescott highway—which bear the brunt of transcontinental travel.

Projects approved in the early Fall of 1936 call for a program of miscellaneous planting on these Arizona highways and for the trimming of trees and shrubs growing along the rights of way. Irrigation was to be provided for both the old and new planting and existing parapets and drainage ditches were to be straightened and reshaped. Another part of the project called for an 8-ft. planting area between curbs and sidewalks on the highway leading into Phoenix from Tempe.

Many of the states did not have statewide programs for roadside improvements, but without exception, their cities, towns and villages sponsored roadside improvement projects of greater or lesser importance.

Retaining Wall Construction.—One of these, involving a high degree of engineering skill, was the project for erection of an effective retaining wall for Richwood Ave. in Morgantown, W. Va. The avenue is built around a hillside. The hillside was slipping slowly, and the retaining wall was necessary to prevent the highway from slipping right on down into the valley. The hill is the site of many nice homes and Richwood Ave. is part of a state highway, so the avenue just had to be saved somehow. State geologists made many borings and a careful study of the rock foundation of the hill. Although it had been generally thought, from casual observations, that the rock foundation slanted sharply and the slipping was caused by drainage caught at the high point of the slant, later and more thorough tests showed that the rock base undulated unevenly. United States Army Engineers were called into consultation and advised the method for building the retaining wall which was successfully used. When a hole for a pier was dug, it was observed for three or four days and then, if there was no evidence of slipping at the base, work was started on the pier. No two pier holes were of the same depth, and wide variations in depth were required in some cases for adjacent pier holes.

Lucas County, Ohio, in which is situated the city of Toledo, had 11 projects for the erection of guard rail barriers and the reshaping of the berms at dangerous places on the roads leading into the city. There had been agitation for many months for elimination of the danger spots and completion of the projects caused much favorable comment.

To the south and west of the business section of Portland, Ore., is a range of hills, varying in height from 600 to 1,000 ft., over which all traffic must pass from Portland south. The two main traffic arteries are Barber and Terwillger boulevards, and at places on both there were heavy over-burdens of loose rock and earth which were inclined to slide and block the highways whenever the earth was disturbed, such as in the making of cuts or fills. Engineers had determined that proper drainage of the water which acted as a lubricant along the planes of slippage would prevent the slides. The city of Portland sponsored a project to drive a 4 ft. by 6 ft. drainage tunnel into the slide area between the two boulevards. Reports are that there have been no slides since completion of the tunnel.

Projects in Smaller Towns.—Smaller towns throughout the country have had their share of roadside improvement projects. An example is found in Suffolk County, N. Y., where roads leading into Babylon, Huntington, Islip and Smithtown were completely landscaped. On some of these roads high earth banks obstructed the view of motorists, the direct cause of serious accidents. The county sponsored projects to remove the hills and to use the excess earth for fills along the roads. After the cuts were made, the bald places were planted either with grass, or, if too steep for grass, with hardy ground covering plants.

In the town of Marshfield, Ore., on Coos Bay, an indentation of the Pacific, the residential section extends back into the hills, and the streets leading to it cross several ravines. At a place on one of the roads was old wooden trestle which had been declared unsafe and which was costly to maintain. The town sponsored a project to remove the trestle and replace it with an earth fill, supported on the lower side by a dry rubble retaining wall. At a comparatively small cost, the project was completed, the danger removed, and the expense of maintaining the trestle eliminated.

Eagleville road, leading into Tiverton, Rhode Island, is 2½ miles in length. Although it carries heavy traffic, it had never received much attention aside from the filling of holes after the spring frost came out. A WPA project was responsible for grading and widening the road, building gutter and cutting brush along the roadside.

Another type of roadside project in Rhode Island was the placing of markers at the entrance to each city and town in the state. The 118 markers required were so constructed as to prevent their defacement by souvenir hunters.

COMPOUND WEATHER AND CLIMATIC CYCLES

By HALBERT P. GILLETTE

IN A PAPER read before the American Meteorological Society, June 26, 1935, I advanced the hypothesis that many weather cycles are harmonic with the earth, orbital period and that they combine with the 12-month cycle to produce compound cycles of great length. For example, I believed that a basic cycle of $103/18 = 5\ 13/18$ years in length caused a compound cycle of 103 years. Subsequently I found that this basic cycle is $63/11 = 5\ 8/11$ years, and that it had a rainfall maximum Dec. 22, 1893, at the time of a maximum of a cycle of 63 years. Hence the compound cycle is 63 years. It will be noted that in this case the supposed harmonic factor, 18, is an even number, whereas the actual harmonic factor, 11, is an odd number. Upon further study of the problem it became evident that if a compound cycle were to attain much amplitude, the harmonic factors should always be odd numbers. For simplicity, let us take a compound cycle of 48 months. At first sight it may seem that it might have a subcycle of half its length or 24 months; but if it did, there would be a peak in the very center of the 48-month curve; whereas if the subcycle were 16 months (the harmonic factor being 3), then a valley of the 16-month cycle would occur at a valley of the 48-month curve, and the amplitude of the curve would thus be increased. Based upon this reasoning, a search was made for compound cycles built up by subharmonic cycles in which the harmonic factors are odd integrals, such as 3, 5, 7, 9, 11. The results of this search have been very surprising.

In the paper above mentioned I announced a cycle of 1825 years, whose subharmonic cycle seemed to be one of $1825/12 = 152\ 1/12$ years. Obviously I had erred as to the latter if harmonic factors are always odd numbers. This led to a review of the data (tree-rings and clay varves); and to the finding of better evidence for a cycle of 140 years than for one of about $152\ 1/12$. This in turn led to a search for the subharmonic cycles that produce a cycle of 140 years. Four of these subcycles were found, namely cycles of 140/35, 140/17, 140/11 and 140/3. All four had coincident sequoia tree-ring maxima in 1866. The $140/35 = 4$-year $= 48$-month cycle had its peak at the December solstice of 1865. But since heavy winter storms in the Sierra Nevada's would cause greater than normal thickness of sequoia rings in the following summer of 1866, it seemed to follow that all four of the subcycles above mentioned had coincident rainfall maxima Dec. 22, 1865. This inference was confirmed by finding that all short rainfall cycles that are harmonics of the 12-month cycle have peaks that occur at the winter solstice. For example, there is a cycle of 1/15 year $= 24.35$ days that has a peak at the winter solstice. This cycle is largely responsible for the short Indian Summer near the middle of November and for the brief "January thaw" near the close of January.

Cycles of 5 and 7 years are to be found in the sequoias, and Halbert S. Gillette has found them in the varves of the Ice Age. These cycles also are harmonic with the 35-year and 140-year cycles.

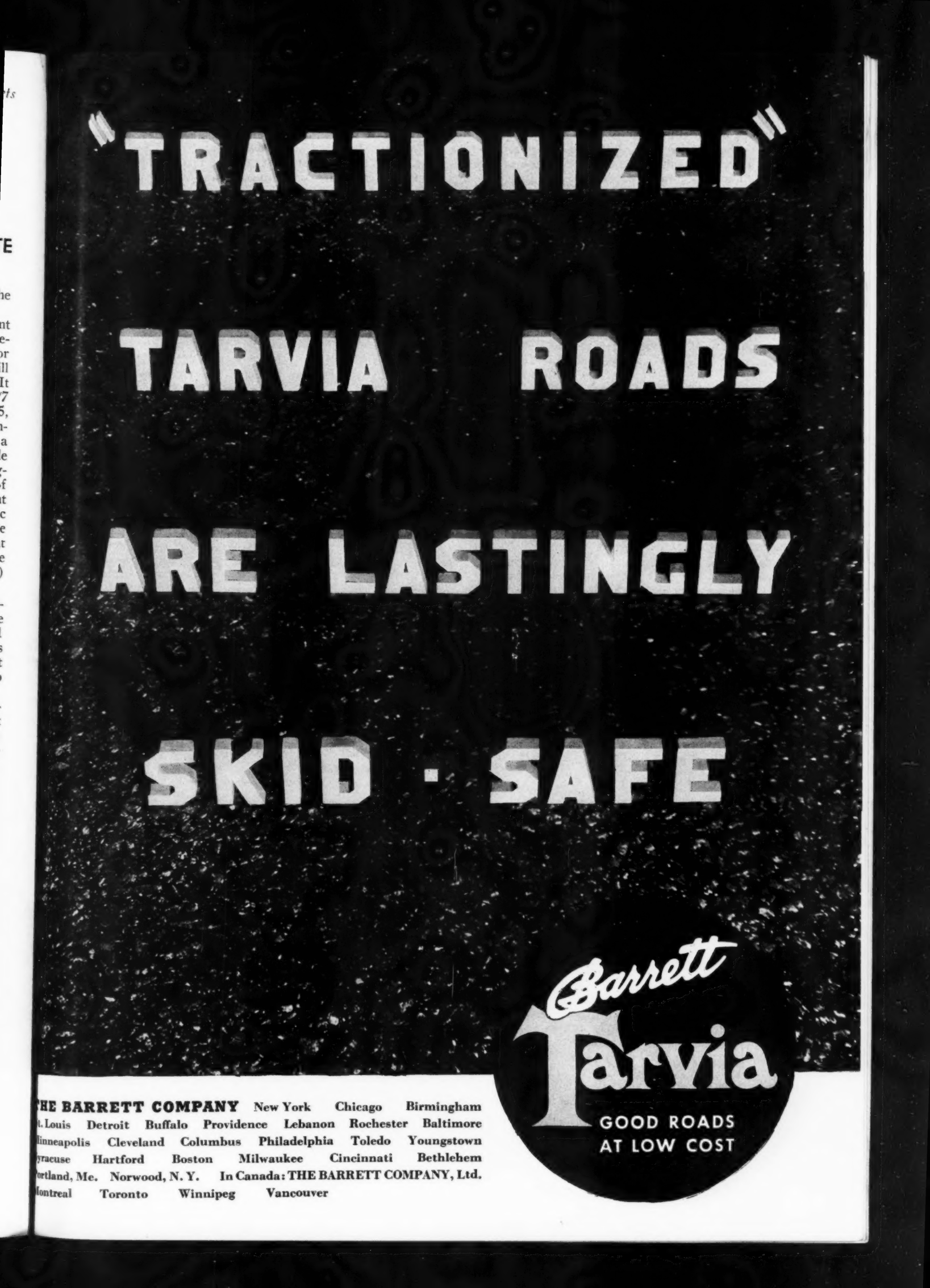
Having found the 140-year cycle, it became evident that it might be a subcycle of the cycle of approximately 1825 years if the latter were exactly 1820 years, for $13 \times 140 = 1820$. In this case it would require still another subcycle to explain the cycle of 1820 years. It might be one of $1820/5 = 364$ years, or one of $1820/7 = 260$ years, but it could not be one of $1820/4 = 455$, for the harmonic factor of the latter is an even number. I recalled that Turner had found evidence of a cycle of 260 to 280 years in sequoia tree-rings, Nile floods, Chinese earthquakes and declination of the magnetic needle; and that Newcomb had found a cycle of similar length in the aberrations of the moon's apparent motion, the latter probably being due to a periodic change in the oblateness of the earth, which would change the length of the day. So I inferred that there might be a cycle of precisely 260 years. I found it first in the sequoias and then in the annual silt laminae (varves) of the Ice Age measured by Antevs.

Based on my hypothesis of compound cycles, the 260-year cycle must have at least one subcycle other than the 12-month cycle, and it turned out to be $260/11 = 23\ 7/11$ years. In my paper of June 26, 1935, I had called this cycle $23\ 5/6$ years. The error was less than 1%; but it was an error that was fatal to my earlier attempt to find a comprehensive system of harmonic cycles.

Since the 140 and 260-year cycles had coincident rainfall peaks in December 22, 1725, that date is the last peak of the 1820-year cycle. The 1820-year cycle is well shown by prominent moraines during the last Ice Age, by terraces in river valleys, by raised sea-beaches, and by a series of floors of calcium carbonate in certain limestone caves. The 140-year cycle shows similar effects on a smaller scale. Its amplitude is greater than that of the 100, 260 and 270-year cycles, because more subcycles have cooperated to produce it. The 140-year cycle is mainly responsible for increasing temperature and decreasing rainfall during the last 70 years.

Having established that short harmonic cycles are capable of generating one of as great length as 1820 years, there was no reason why much longer cycles might not be similarly produced, even up to cycles millions of years in length. Corresponding to the least common multiple of any two compound cycles there should be a compound cycle of still greater amplitude if the harmonic factors are odd integral numbers. In my paper of June 26, 1935, I pointed out that, as a rule, the longer the cycle the greater the up or down swing (amplitude) of its curve. The reason for that peculiarity is now clear, and it is also clear why there are certain exceptions to the general rule, such as the 140-year cycle, when a greater number of subcycles are involved in producing a compound cycle.

The following are 7 important compound cycles that combine to produce longer ones, their respective lengths in years being exactly: 35, 49, 63, 100, 140, 260 and 270.



THE BARRETT COMPANY New York Chicago Birmingham
St. Louis Detroit Buffalo Providence Lebanon Rochester Baltimore
Minneapolis Cleveland Columbus Philadelphia Toledo Youngstown
Syracuse Hartford Boston Milwaukee Cincinnati Bethlehem
Portland, Me. Norwood, N. Y. In Canada: THE BARRETT COMPANY, Ltd.
Montreal Toronto Winnipeg Vancouver

Their least common multiple is 1,719,900 years, and they had coincident peaks Dec. 22, 91,095 B.C. It would be impossible to determine any such remote date of rainfall maximum with accuracy, were it not for the harmonic relationship of the short subcycles. The thought naturally suggests itself that 91,095 B.C. may have been the time of the maximum crustal uplift, or "geological revolution," that divided the Pleiocene from the Pleistocene period.

That there is a geological cycle of the order of 1,700,000 years was shown by Prof. L. D. Stamp ("Seasonal Rhythm in the Tertiary Sediments of Burma," Geological Magazine, 1925, p. 515-528). He measured enough annual varves to enable him to determine that about 2,500,000 years were required to deposit all of the rocks of the Oligocene and half of the Miocene Period in Burma. This is equivalent to about 1,700,000 years per Geological Period. He said: "A million years has sometimes been regarded as a mere bagatelle in geological time. In Burma it has been sufficient for the deposition of between 5,000 and 10,000 ft. of sediment. The duration of the Oligocene and half of the Miocene is probably in the neighborhood of 2,500,000 years."

In discussing Stamp's paper William W. Ruber (Professional Paper 165, U. S. Geol. Survey, 1930) said: "Stamp's results seem to accord with the writer's in suggesting that the estimates (of rock ages) based on lead-uranium ratios . . . may be too long or that inconspicuous stratigraphic breaks may be very common."

Seven years ago in "Engineering and Contracting," I suggested that the lead-uranium formula for rock-ages may be grossly erroneous because the helium that is a product of the disintegration of the uranium accumulates in the rock and may accelerate that disintegration. The evidence of the varves in rocks has shattered the reliability of any existing atomic disintegration formula for measuring the ages of rocks.

If helium hastens disintegration of uranium, may it not point the way toward effecting the artificial disintegration of certain atoms with an accompanying production of great energy in an economic manner?

There is good evidence of a cycle of about 26,000 years, presumably due to the gyration of the earth's axis. That cycle is not harmonic with the earth's orbital period, and therefore is not harmonic with any of the cycles above mentioned. Yet they may all have the same basic cause, namely periodic variations in the number of solar electrons that enter our atmosphere. Harmonic gyration of electron-shells that encase the earth would produce not only the short but the long cycles above mentioned, excepting the 26,000-year cycle; and such gyrations would cause periodic variations in the number of solar electrons that enter these electron-shells, which in turn would affect many terrestrial phenomena including weather. Similarly the gyration of the earth's axis would cause a weather cycle of about 26,000 years.

About 16,400 B.C. the axes of earth and sun were nearly in the same heliocentric longitude at the solstices, about June 22 and Dec. 22, with opposite poles of earth and sun pointing most directly toward one another. Since electrons emitted by the sun would spiral around its magnetic axis toward both poles, they would have magnetic polarity corresponding to that of the pole whence they escape. Hence they would be most attracted by the opposite magnetic pole of the earth, as well as that of each rotating electron-shell that encases the earth. This would give to the 26,000-year weather cycle the same basic cause as that of the cycles due to gyrating terrestrial electron-shells. Moreover, the sun is presumably encased also in harmonic gyrating electron-shells that cause the sunspot cycles. That sunspot cycles are not harmonic with the earth's orbital period is certain. Although the great sunspot cycle of about 11.136 years has affected the thickness of the sequoia rings and the varves, those effects are of less importance than those of the cycles above mentioned.

By aid of these cycles I have been able to date annual varves of the last Ice Age. For example, Antevs' varve number 4404, near Northampton, Mass., was laid down by the runoff in the spring and summer following the precipitation maximum of the 1820-year cycle which was Dec. 22, 12,855 B.C. The peak of the 1820-year cycle in 16,475 B. C. was the one nearest the peak of the 26,000-year cycle. Hence about 16,475 B. C. the 1820-year cycle produced the great terminal moraines of the last Ice Age, namely the Brandenburg Moraine in Germany, the Ronkonkoma Moraine on Long Island, N. Y., the Shelbyville Moraine in Illinois, and the Altamont Moraine in North Dakota.

The substages of the last Ice Age were each 1820 years long. There have been three Ice Ages, about 26,000 years center to center, since the 91,095 B. C. date given, the earliest of the three being the greatest. It was what geologists call the Nebraskan Glaciation during which a very thick bed of glacial till was deposited. In Nebraska this till bed is 100 ft. thick at its maximum. On top of it lies a maximum of 240 ft. of interglacial sands, gravels, etc., and then comes the Kansan till bed whose maximum thickness also is 100 ft. On top of that is another bed of interglacial deposit whose maximum is about 230 ft. where wind-blown materials do not exist. American geologists call the last Ice Age the Wisconsin Glaciation. They have occasionally erred in regarding some of its 1820-year substages as independent Ice Ages.

I have found several earthquake cycles that correspond with rainfall cycles above mentioned. I infer that there is an electronic activity in the earth's molten core corresponding with that in the atmosphere. This inference is sustained by two known cycles of variation in the rate of axial rotation of the earth, as well as by the cycles so clearly shown in many series of raised ocean beaches.

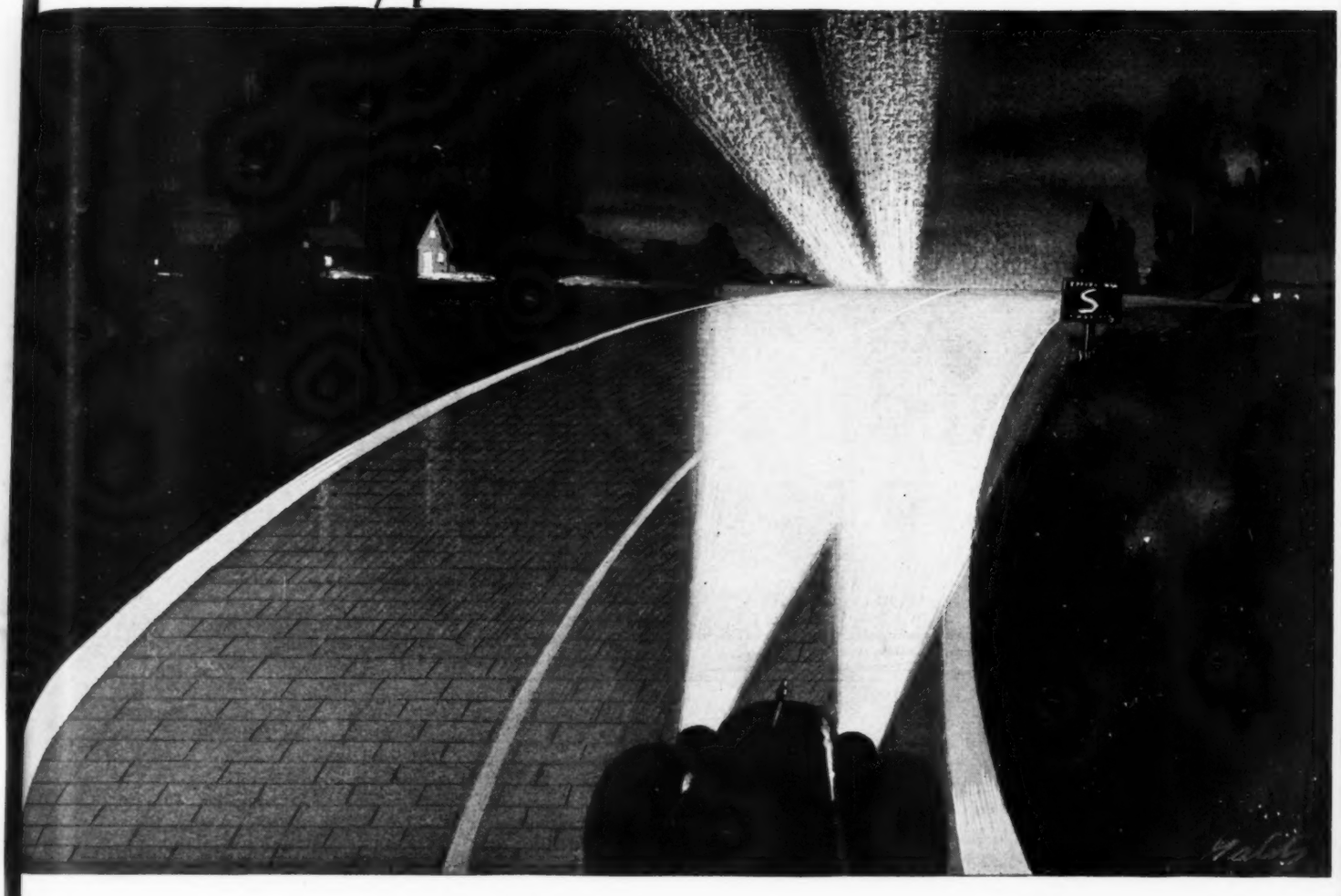
In a forthcoming paper analyses of the data used in deriving the above given cycles will be published. Another paper will give some of the outstanding historical effects of the 140 and the 1820-year cycles. A third paper will discuss the geological and topographical effects of climatic cycles.

▼

Oregon Highway Report

Oregon, too, has just sent in its latest biennial report dealing with the period July 1, 1934, to June 30, 1936, incl. The report estimates 1937 prospects and in the discussion struck a blue note. It states that as a result of having to obligate 1937 funds in 1936 in order to take advantage of all federal aid offered, the department will go into the 1937 construction year with approximately $1,750,000 of its 1937 income already pledged. This will force postponement to 1938 of some $2,000,000 worth of federal aid work that would otherwise have been done in 1937. A welcomed inclusion in Oregon's report is the tabular and explanatory matter regarding county and market road systems.

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Euclid Ave. Bridge, Des Moines. This Structure, Built in 1934, Is Typical of Numerous Continuous Girder Bridges Now Planned or Under Construction in Des Moines and Elsewhere in Iowa.

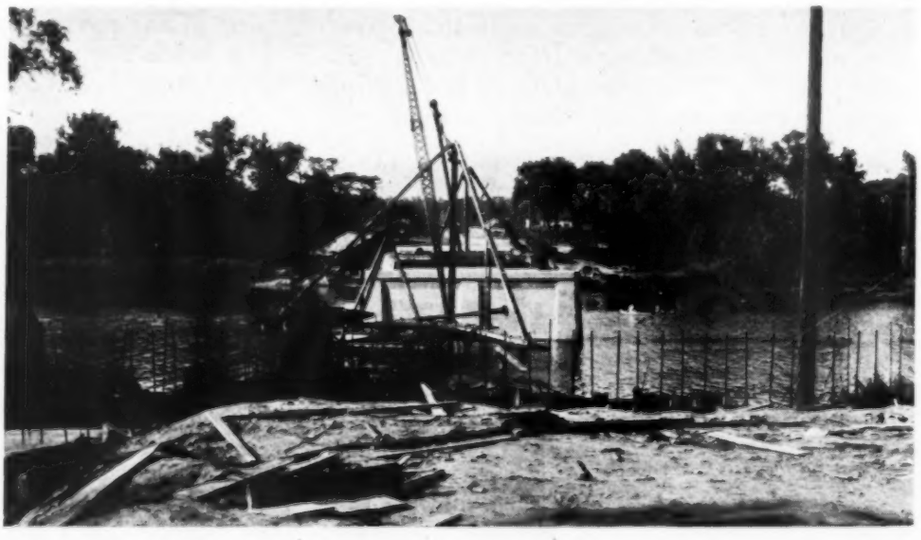
Photos by the Author.

BRIDGE AND VIADUCT CONSTRUCTION TO SPEED TRAFFIC THROUGH DES MOINES

By JOHN C. BLACK
Field Editor, Roads and Streets

SEVERAL major highway structures are now being built in the city of Des Moines, Iowa, the most important being the East Fourteenth Street viaduct across railroad yards in the Des Moines River valley, the East Fourteenth Street bridge over the river, and the Eighteenth Street bridge over railroad yards and the Racoon River. A fourth bridge of considerable size is to carry Second Street over the Des Moines at Union Park. Plans have been completed for a viaduct on S. W. Twenty-first Street, but the contract has not been let.

All of this work is under the jurisdiction of the Iowa



Second St. Bridge Piers, Sept. 9, 1936. Top of Cofferdam Piling and Reinforcement for South Pier in Foreground. The Wide Expanse of Water Is Caused by a Dam a Little Way Down Stream



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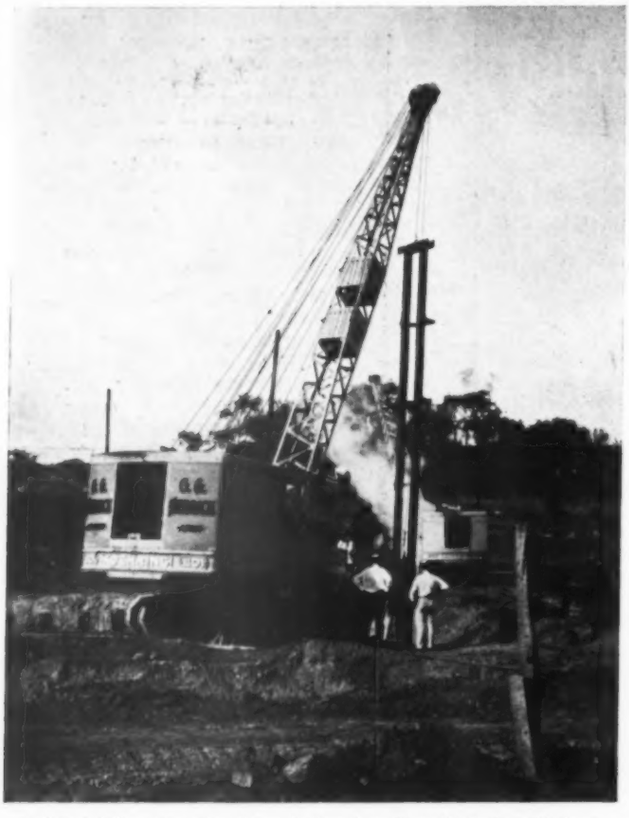
PAGE *Traffic* TAPE

State Highway Commission, Fred R. White, Chief Engineer. E. W. Blumenschein is Engineer of Bridge Design and Don L. Teal is Resident Engineer in charge. Financing has been through the WPA.

East Fourteenth Street Viaduct and Bridge

This project is intended primarily as a by-pass to take the heavy through traffic of U. S. Routes 65 and 69 away from the business center of the city. The importance of these highways may be judged from the fact that Route 65 leads from northern Minnesota through Minneapolis to Des Moines and thence to Little Rock, Baton Rouge and New Orleans; while No. 69 extends from Albert Lea, Minn., through Des Moines to Kansas City and southward to Port Arthur, Texas. The two routes are combined on a single highway through Des Moines and for a distance of some 20 to 30 miles on each side. This highway enters Des Moines from the north on East Fourteenth Street, and at present turns westerly on Grand Avenue to pass through the business district and thence to an exit via Seventh Street and Indianola Boulevard. On this course it crosses both the Des Moines and Racoon River. East Fourteenth Street lies well outside the area of major congestion, and the new route will simply continue it to the south, across the river, and out of the city.

In considering traffic it should be noted also that there is a junction with U. S. Routes 6 and 163 and State Route 88 at East Fourteenth St. and Grand Ave.; and that these important easterly and northeasterly highways will now be given an uncongested southerly connection. Difficulties in crossing the river valley, plus the lack of great necessity until recent years, have heretofore prevented the opening of East Fourteenth St. on the line of the present project.



Pile Driving for Pier Foundation for East 14th St. Viaduct, Sept. 9, 1936. Koehring Crane with McKiernan-Terry Double-Acting Hammer Operating at 34 Blows Per Minute. Boiler Supplying Steam to Hammer Located to the Left Outside of Picture. In the Background a Koehring Dragline Excavating for Another Pier Foundation. This Picture Was Taken Toward the Northerly End of the Viaduct



Looking North On the Axis of East 14th St. Viaduct, Sept. 9, 1936. Foundation Reinforcement in Foreground—Northerly Rim of Des Moines River Valley in Background

The improvement begins at Grand Ave., with the widening and repaving of East Fourteenth St. for about ¼ mile. This is followed by ¼ mile of new construction from the end of the old paving on Fourteenth St. to the edge of the bluff where the viaduct begins. Grading on this section totals 78,000 cu. yd.

The viaduct will be 1,429 ft. 9 in., or 0.27 mile long, of the continuous steel girder type, with 22 spans, supported on concrete pedestal piers, founded on creosoted piles. The overall width will be 60 ft., with a 42-ft. roadway and two 6-ft. sidewalks. The design is for American Association of State Highway Officials H-15 loading. Maximum height above ground level is 39 ft. The grade is 2 per cent. Eighteen railroad tracks and one street will pass under the structure.

From the end of the viaduct the road will be continued on a 5 to 10-ft. fill ⅓ mile to Des Moines River, which will be crossed by a 6-span 788-ft. 5-in. continuous steel girder bridge

From the river bridge the improvement will consist of about 3 miles of 20 ft. pavement, a part of which is on an existing city street.



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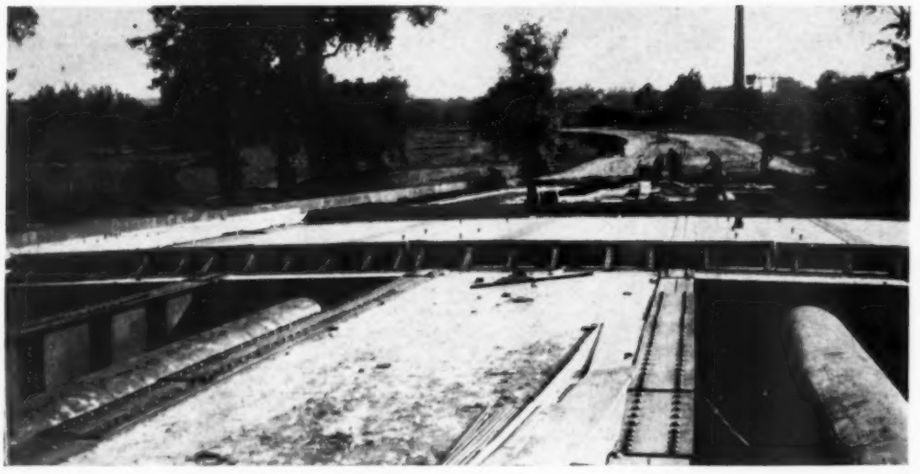
Some fellow once said, "You get what you pay for." A good phrase but not always true except when buying Williamsport Wire Rope.

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Deck Construction at Southerly End of 18th St. Bridge, Sept. 9, 1936. Note the 30-in. Water Pipe on Each Side of Center Girders

The length of the entire project is about 4 miles. Contracts for the two bridges have been let as follows:

Viaduct—
G. G. Herrick Construction Co., Des Moines $294,473
Des Moines River Bridge—
A. A. Kramme Co., Des Moines..... $219,094

Completion of the two structures is planned for August 1, 1937.

Eighteenth Street Bridge

This structure affords an improved connection for Des Moines with Iowa State Route 28 to the southwest. It begins at Locust St. and Grand Ave., and passes over several railroad tracks before reaching the Racoon River. It also is of the continuous girder type, there being 12 spans ranging from 30 to 110 ft. in length on concrete bents. There is a concrete girder approach span at each end.

The total length is 947 ft. 4 in. There is a 42-ft. roadway with a 5-ft. sidewalk on each side. Over all width is 57 ft. In addition to roadway and sidewalks the bridge carries two 30-in. water mains which form an important part in the city's water supply system. Although the deck was still incompleted, these mains were in service when I visited the project early in September. Their location on the bridge assures much greater safety to the city's supply than has heretofore prevailed.

Beyond the bridge the road is carried about ¼ mile on a fill to its connection with S. W. 21st St. This portion will be given an 8-in. reinforced concrete pavement, 42 ft. wide from face to face of curbs.



Eighteenth St. Bridge Over Racoon River Nearing Completion, Sept. 9, 1936. The River (Not Visible in the Picture) Flows Between Piers in Middle Distance

The bridge was built by Snyder & Johnson of Humboldt, Iowa, for $230,482. Grading was by O'Rourke Construction Co. of Des Moines. The paving contract has been let to O'Rourke Construction Co. The project was opened to traffic in November.

The Second Street Bridge at Union Park

This is to be a 500-ft. structure carrying important north and south traffic from a large residential area across Des Moines River and thence to the business center of the city. It will relieve Sixth Ave. and the Sixth Ave. bridge of a large amount of local traffic, and will also carry a portion of the traffic of State Route 60.

The bridge consists of 5 continuous steel girder spans on concrete piers, founded on steel piles. The longest span is 110 ft. There will be a 42-ft. roadway and two sidewalks. Over-all width of superstructure, 55 ft. All pier foundations were constructed in cofferdams.

The estimated cost is $126,919. Snyder and Johnson of Humboldt, Iowa, are contractors.

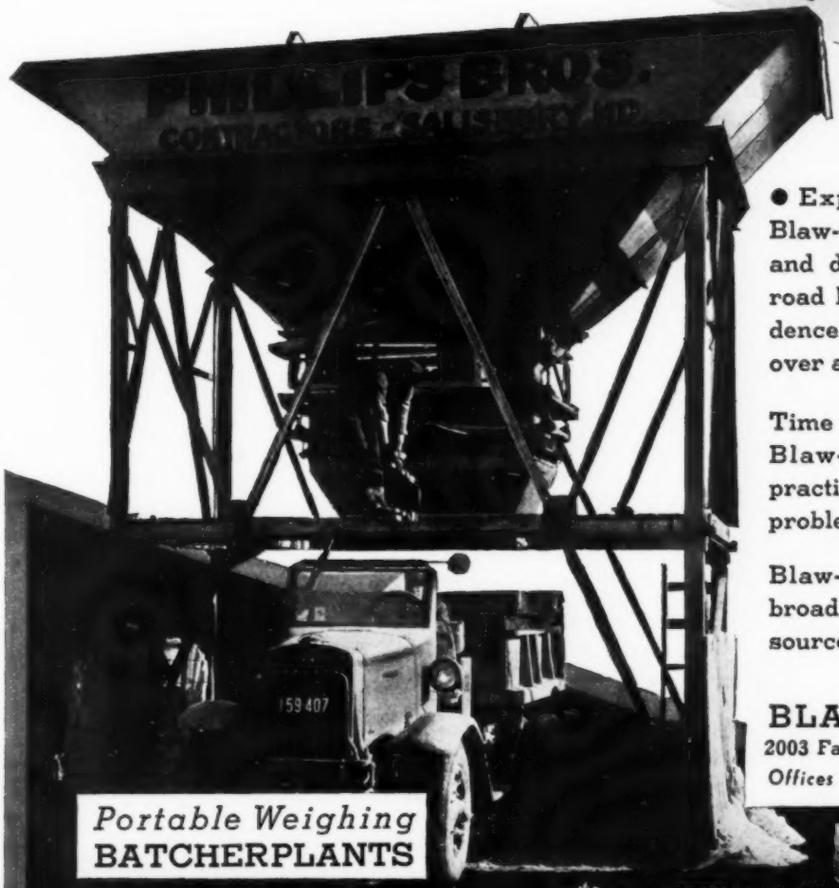
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Bridge Care and Repair

A check of every highway bridge in Minnesota by special crews to paint, repair and recommend heavier improvements has been ordered by the Minnesota Highway department.

These crews will make temporary repairs at least twice annually, correcting such items as plugged drains, bent railings, rusty spots on steel, missing bolts and railings, loose nuts on railing bolts and loose expansion plates. The crews will also remove dirt and sand from bridge floors and truss members and from bridge seats around roller or rocker bearings, clean out channels under bridges, and cut all brush and trees under or adjacent to bridges, correct excess washing or cutting of banks under or adjacent to bridges, correct excess washing or cutting of banks under bridges and do spot coat painting where necessary. The crews will report bridges which should be painted, repaired or widened during the season, note conditions of steel as to per cent of rusty surfaces, and report bridges that require repairing, strengthening, new floor systems and replacements. The state has a heavy investment in its highway bridges and intends to protect it.

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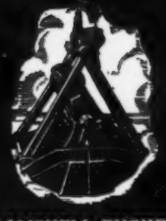
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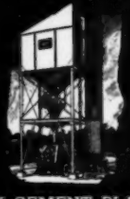

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Arrangement for Studying Action of Snow Plows

THE TRUCK MANUFACTURER LOOKS AT SNOW PLOWS

By J. R. SHANNON
Engineering Department, Four Wheel Drive Auto Company

SNOW removal annually presents a provocative problem to the truck manufacturer as well as to the highway engineer. If plows and motive power properly coordinate their mechanical features, the problem is minimized. When either plow or motive power fail, for some reason, the problem becomes pregnant with trouble.

Rather than invite criticism for the possible failure of a snow removal unit to function properly, the Four Wheel Drive Auto Company has recently studied the problem to determine where improvements could be made in either its trucks or the snow plows used with them. The result has been illuminating. Distinct flaws in the design of some V-type plows were revealed by the thorough research which accompanied the investigation. Conditions which the company believed were a detriment to snow removal by its trucks were carefully analyzed. Findings were reported to plow manufacturers, and it is believed that beneficial results have occurred from the research.

When the research was begun, we first attempted to answer these questions:

Do our trucks function properly with all of the plows mounted upon them?

Are the Four Wheel Drive trucks using these plows placed at a disadvantage compared with other trucks using other plows?

This, we felt was our own vital problem—one which could not be termed as merely the problem of the plow manufacturer.

Not all plow manufacturers agree on the proper width of plow for large, heavy duty trucks. Several well known makes of heavy duty V-type plows have various widths of cutting edges. For obvious reasons, in considering four well known makes of V-type plows, we termed them "A," "B," "C" and "D." Their respective widths at the cutting edges were: Plow "A," 8 ft.; Plow "B," 8 ft., 4 in.; Plow "C," 10 ft., and Plow "D," 10 ft., 2 in. It is claimed by some plow manufacturers that the opening of heavily drifted and hard-packed roads is primarily the job of narrower plows which are sometimes called "breaking plows." Manufacturers of wider plows have maintained that since their plows cut wider and cleaner paths, they are more practical for general plowing purposes, and for widening out after the first cut. It may be that the narrower plows are "hold overs" from the time when truck treads were narrower. The tendency, however, now seems to be toward plows with wider cutting edges.

It is quite obvious that a plow of a given shape, 8 ft. wide, requires less power for operation than one 10 ft. wide (where all other conditions are equal) and will break through where a wider plow would not. The use of a plow less than 10 ft. wide on a truck with 72 in. tread, however, makes it difficult to mount the wing guides inside the path cleared by the plow, and at the same time far enough outside the front wheels to allow steering clearance. In some cases this condition is overcome by moving the plow far enough ahead of the truck so that the wing guides extend in front of the front wheels. This increases the overhung weight on the front axle, and results in more side thrust on the front wheels, when widening or plowing where the snow is deeper on one side than on the other.

Another method of meeting this condition is to set the plow as close to the truck as possible, and mount the wing guides onto the body of the truck just back of the cab. Its disadvantages is that it leaves a wide gap between the rear of the plow and front end of the wing. Snow tends to fall back into the roadway from the rear of the plow through this gap, and get under the wheels of the truck reducing traction, and making it difficult

to back the plow out of the cut. The advantage of this mounting is that it is more rigid, and permits the use of a longer wing and takes the weight of the wings off the front axle and off the plow raising and lowering mechanism.

During the past snow season we made some field observations of plows under various working conditions.

Here in Wisconsin where the counties own most of the road maintenance equipment, the state roads are opened first, the county roads next, and where the townships have no equipment of their own, their roads are opened last. As a result the latter sometime remain closed for a week or more during which time the snow becomes hard-packed. Often these roads have high frozen banks on each side caused by previous plowing. This condition is one of the most difficult that a snow removal unit is called upon to meet. It requires a truck with plenty of power and traction and a plow with the right moldboard shape to lift the snow over the bank.

It was under these conditions that we studied the action of a number of makes of plows. We then took measurements of them, and built accurate models on a scale of ½ in. to the foot. After considerable research work in an attempt to find a satisfactory plowing medium, we found powdered air-slaked lime, slightly dampened with kerosene, to have the general characteristics and appearance of snow. By working the plow models in this material and attaching them to a spring scale, we were able to determine the relative power required by the various models, and to study the snow movements produced by them.

In the experiments, the condition of blocked roads with hard packed snow and high frozen banks was duplicated. A long narrow box, having no removable partitions running lengthwise, and made to represent banks 6 ft. high and 14 ft. apart according to the scale used, represented a stretch of snow-blocked highway. The bottom of the box was corrugated so that the plowing medium would stick to the bottom and not slide endwise under the pressure of the model plows. The artificial snow was packed between the model snow banks to a uniform depth, on each trial. A stout cord, wound onto a small winch drum, operated by an electric motor through a reduction gear, pulled the models through the artificial snow at a uniform plowing speed. The spring scale used to obtain the reading was interposed between the models and the winch. Five tests were run on each model. The average pull required was as follows: Plow "A," 7 lbs.; Plow "B," 7.6 lbs.; Plow "C," 9.5 lbs., and Plow "D," 9.6 lbs. The widest plow "D," required the most power while the narrowest "A," required the least.

After each trial the snow which had been lifted over the bank and dropped into the outer portion of the box, was weighed, and record kept of it. Thus, not only was the required power measured, but the work done by each plow (as measured by the snow lifted over the bank) was determined also.

Another model was then constructed of plow "D," but narrowed down to an 8 ft. width at the cutting edge, the same as plow "A." Upon testing this plow, we found that it took almost as much power as the full-sized plow "D" model. From this we concluded that the power required to push a snow plow depends as much, if not more, upon the shape as upon the width at the cutting edge. We concluded too that it would be possible to build a 10 ft. plow requiring very little more power than an 8 ft. plow if the shape were correct. It was also quite apparent that the shape of this particular plow ("D") needed improvement. Since many of our trucks were being equipped with plow "D," we felt that their efficiency as snow removal units was being seriously impaired, and that something should be done about it. Accordingly we pointed out this condition to the manufacturers of plow "D" and demonstrated it to them. As a result, they have conducted similar experiments and have developed a new model for this season that seems to have real merit. Although its cutting edge is 10 ft. wide, on test it requires very little more power than the narrow plows, and much less than the old model of the same make.

The study of the problem of snow control, by means of miniature models, has been done by other engineers also. The Michigan Engineering Experiment Station, East Lansing, Michigan, has studied snow drifting as caused by various types of barriers both artificial and natural. The model equipment included miniature trees, snow fences, and other barriers all built on the scale of ½ in. to the foot—the same scale as we have used in our experiments. The Michigan models were studied in a wind tunnel in which wind velocities up to 45 miles per hour were obtainable. A medium comparable to snow was used in the experiments by means of which the variables entering into drift formations were studied.

The import of the Michigan study together with ours shows the trend among highway and equipment engineers to successfully solve the snow removal problem by scientific means rather than by "rules of thumb" or guesswork.

As important as the proper design and mounting of plows, is the handling of snow removal equipment by drivers. Many highway departments may find fault with the equipment when the fault is really that of a driver mishandling this expensive equipment.

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The Maryland Road Situation

Maryland is a proving or test grounds today for highway program promotional work. The Governor has played a most interesting hand. A few days ago he announced his budget. In a preview of the budget requirements a short time ago he announced his intention of diverting some $7,600,000 for the next biennium to balance an increased budget. He made this as an unqualified statement at the time and brought upon himself a thumping attack from all sections of the state. This attack was undoubtedly inspired by the promotional efforts for a modernized highway system.

The Maryland legislature is in session and when the final budget message was read it was discovered that the Governor had passed a rather hot potato directly to the legislature and had then faded out of the picture. He announced that he was entirely against diversion of any kind and thought that a constitutional amendment should be passed to prevent not only future diversions but even those that he proposed himself. Anomalous as it may sound, his reasoning is rather good. The message means that the legislature will have to find other sources of revenue for the Governor or else suffer vigorous public disapproval of diversion of highway funds.

The prevailing condition now seems to be, how can Maryland modernize their highways if they are going to divert highway funds?

Looks to A. Puddle Jumper like a bond issue would solve the problem—as $100,000,000, 15 years, 3½ per cent bonds.

SEEN AND HEARD AT THE A.R.B.A. CONVENTION AND EXHIBIT

READERS of ROADS AND STREETS who did not attend the convention and exhibit of the American Road Builders' Association at New Orleans, Jan. 11 to 15 inclusive, may be interested in the following brief account.

This being the odd year, that is, the year in which the Association omits its big show, only a modest display was planned. Heavy equipment was omitted, and many manufacturers utilized their space merely for pictorial exhibits and as meeting places for friends and customers. In all, 131 producers and associations had spaces in the exhibition hall. In addition, there were displays by ten states, the U. S. Bureau of Public Roads, U. S. Department of Commerce, the Republic of Mexico and the Aetna Life Insurance Company.

Do you think you drive well? If so, Aetna Life, with its "steerometer," would have given you a chance to prove it—or perhaps, as with a good many, to disprove it. Aetna was far and away the best patronized exhibitor in the building. The "steerometer" consists of a seat and steering wheel, in front of which a pictured road and auto hood move in peculiarly realistic manner. The trick is to keep the hood on its proper course, and the score is marked on the dial card. The test was tougher than it looked.

A nearly complete list of exhibitors and the products they featured was given on pages 144 to 148 of the January issue of ROADS AND STREETS.

The convention's technical sessions were held in various smaller rooms in the auditorium. A few of the



W. P. MacDonald, Flushing, N. Y., Contractor.



R. E. Brooks, Cleaver-Brooks Mfg. Co., Milwaukee, Wis.



B. E. Gray, Highway Engr., Asphalt Institute, New York



Model of Lima Locomotive Crane at A. R. B. A. Exhibit



J. G. Schaub, Michigan State Hwy. Dept.

But lack of size does not mean lack of merit. With scarcely an exception, the displays were interesting and attractive, and the booths comfortably and pleasantly arranged. Extensive use was made of moving pictures —both with and without sound—and there were many very fine working models as well as actual equipment not too large to fit the general scale of the exhibit.

many excellent papers and discussions will be printed in ROADS AND STREETS. The main subjects of the meetings, on each of which several papers were presented, were as follows:

Stabilized Road Construction
Safe Highways
County Road Design and Construction



C. S. Johnson, C. S. Johnson Company, Champaign, Ill.



"Abe" Linker, Commissioner, Mississippi State Hwy. Comm.



Geo. P. Thigpen, Asst. Mtls. Engr., Alabama State Hwy. Dept.



C. A. Koehring, Koehring Mfg. Co., Milwaukee, Wis.



Lion Gardiner, Vice-Pres., Jaeger Machine Co., Columbus, Ohio.

Again the Bureau of Public Roads presented a series of dioramas depicting the progress of American roads—a series entirely different from those shown last year at Cleveland. Mexico interested all comers with a collection of fine pictures in a characteristically decorated booth, where two courteous young ladies gave information in either English or Spanish. Missouri gave an astounding display of its forests and forest products—one of the largest of all the exhibits.

County Maintenance
Development of Highway Construction Equipment
City Officials' Problems
County Officials' Problems
Gas Tax Diversion
Highway Contractors' Problems
County Administration, Legislation and Finance
Asphalt Paving Technology
Roadway and Airport Drainage



A. H. Hinkle, Kentucky Rock Asphalt Assoc., Louisville, Ky.



Ray Giddings, Calcium Chloride Association, Detroit, Mich.



Joe Stein, R. H. Schmidt, H. M. Daniels, F. W. D. Auto Co., Clintonville, Wis.

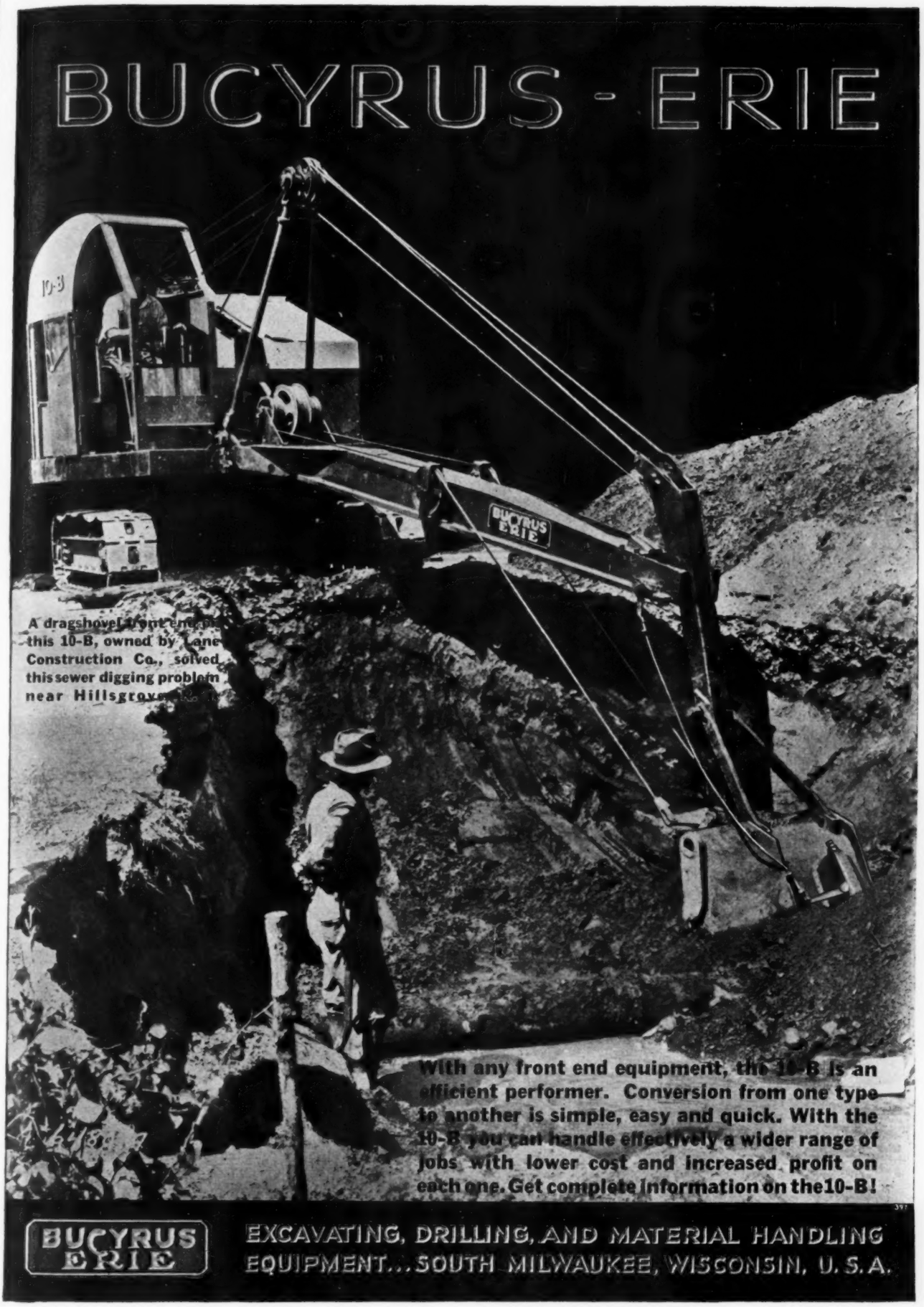


Maj. Geo. W. Farny, County Planner, Morris Plains, N. J.



Gibb Gilchrist, Chief Engr., Texas State Hwy. Comm.

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A dragshovel front end [illegible] this 10-B, owned by Lane Construction Co., solved this sewer digging problem near Hillsgrove, [illegible]

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EXCAVATING, DRILLING, AND MATERIAL HANDLING EQUIPMENT... SOUTH MILWAUKEE, WISCONSIN, U. S. A.



Laura Bowling and I. Zaragoza, Mexico City, Mex., Morelos State Hwy. Representativee.



C. S. Nichols, City Engineer, Miami, Fla., and E. Freedman, County Engineer, Dade County, Fla.



J. T. Pauls, U. S. Bureau of Public Roads, Washington, D. C.; F. H. Gilpin, The Texas Company, New York



Ed Botten, Owen Bucket Company, Cleveland, O., and W. A. Browning, Browning-Ferris Mchy. Co., Dallas, Tex.



Geo. McNutt, Baton Rouge Distributor, and John Brock, New Orleans, Contractor

Pan American Affairs
Education
City, County and State Planning Legislation

Social events were more numerous than usual. Included among them were a City Officials' Supper, Old Timers' Dinner, Contractors' Supper Dance, Road Builders' Banquet, International Reception and Ball, and numerous inspection and sight-seeing trips.

What seemed to be the only fair complaint was that New Orleans hospitality drew over much from the exhibit, which, in spite of a large registration of road builders, failed to get the attendance it deserved.



E. J. Goes, Adv. Mgr., Koehring Co., Milwaukee, Wis.; Howard Landgraf, KVP Dunlap Assoc., Milwaukee, Wis.; Jim O'Niel, Manufacturer's Trust Co., New York; P. N. Hall, Manufacturer's Trust Co., New York; "Tommy" Tucker, Gen. Mgr., Good Roads Machy. Corp., Kennett Square, Pa.



H. B. Olson, County Highway Commissioner, St. Croix County, Wis.; K. E. Brunsdale, Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.



W. H. Mills, So. Car. State Hwy. Dept., and a part of Earl Klinger, West Virginia Dept. of Highways.





Philip Kelly, J. I. Smith, A. J. Even, W. C. Mealer and Frank Hingle, Hoist and Shovel Operators, New Orleans, La.



R. A. Harris, Chief Engr., Mississippi State Hwy. Comm.; J. J. McNamara, Asst. Engr., State Hwy. Comm.; J. E. Boyd, Testing Engr., Georgia Hwy. Comm.; Geo. P. Thigpen, Asst. Mtl. Engr., Alabama State Hwy. Comm.

A Brief Review of the 23rd Annual Road School at Purdue University

Perennially fresh is the "Purdue Road School." To its five-day sessions come county engineers, road supervisors, and others from all parts of Indiana, and from some points outside the state. And from these sessions they go back to their jobs with added technical knowledge, first hand observations on new machines and materials, new ideas, sharpened wits, and the stimulation of spirit we all occasionally need.

The 1937 meeting—held Jan. 25 to 29—was disappointing only because of the absences due to detention of a considerable number of state and county officers on flood duty. Even Mayor Teal of Lafayette, who was to have made a welcoming speech at the Monday evening smoker, was obliged to cancel the engagement in order to perfect arrangements for the care of 500 refugees arriving next morning from the south. City Engineer, Harry Overesch, spoke in his place, and emphasized the hospitality which was conspicuously extended throughout the week.

It is not necessary to list here the various papers presented at the technical session. A few of them will be reprinted in future issues of ROADS AND STREETS. The subjects were varied, ranging from such matters as cooperation, financing, and legislative action to purchasing, drainage, structural stresses, and the construction and maintenance of various surfaces. The speakers included representatives of the Indiana and other state highway departments, members of Purdue and other university facilities, county engineers, county supervisors and others. To Ben H. Petty, Professor of Highway Engineering, goes the chief credit for the well organized and smoothly running program.

The Highway Materials and Equipment Association, under the direction of its president, C. Dana Ward, staged a most creditable display in the Purdue armory; in addition to which, they provided two evenings of excellent entertainment. Exhibitors at the show were as follows:

J. D. Adams Company, Allied Truck Equipment Company, American Concrete Expansion Joint Co., Austin-Western Road Machinery Co., Hugh J. Baker Mfg. Company, Barber-Greene Company, Barrett Company, Butler Sand Distributor Company, Carlisle Instrument Company, J. I. Case Company, Chevrolet Motor Company, The Construction Digest, D-A Lubricant Company, A. F. Deaney, Eugene Dietzen Company, James H. Drew Company, The Foote Company, Inc.; Ford Motor Company, Galion Iron Works & Mfg. Co., Gledhill Road Machinery Co., B. F. Goodrich Company, C. E. Griener Company, Inc.; Highway Steel Products Co., W. J. Holliday & Company, The Huber Mfg. Company, Indiana Equipment Company, Ind., Mineral Aggregates Association, Indiana State Industries, Insley Manufacturing Company, International Harvester Company, Jackson Engineering Company, Keuffel & Esser Company, Laclede Steel Co., The H. Lieber Company, Marmon-Herrington Company, Ohio Oil Company, The W. Q. O'Neall Company, A. J. Orr Company, Inc.; Parkrite Corporation, Pioneer Gravel Equipment Mfg. Co., Portland Cement Association, Root Spring Scraper Company, Jacob Rose, Scott Supply Company, Standard Oil Company, H. W. Taylor Company, Truscon Steel Company, United States Steel Corporation, White Manufacturing Company, The White Motor Company, Willett Manufacturing Company, Winslow Gov. Standard Scale Works, Inc.



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Fig. 1—East Portal, Showing Timber Truss to Carry the Old Highway.

CONSTRUCTION METHODS ON TOOTH ROCK TUNNEL

By HENRY W. YOUNG

AS A PART of the reconstruction work on the Columbia River Highway, necessitated by the building of Bonneville Dam, Tooth Rock Tunnel stands out as a feature interesting from a number of angles. It is a project of the U. S. Bureau of Public Roads (D. H. Cadmus, Resident Engineer), and is about a mile upstream from the dam, the latter being 41 miles from Portland, Ore. Work was well advanced by the first of October, excavation being complete some 300 ft. from the east end while the west end was through into solid rock of a nature requiring no further timbering. The total length will be 827 ft. Orino, Birkemeier & Saremal, of Bonneville, Ore., are the contractors. The amount of the contract is $225,000.



Fig. 2—West Portal, Showing Method of Placing Timbers in Side Drifts and Top Heading by Starting Ring Arch from the Inside and Working Out. The Arch Ring Is Just Breaking Through to the Outside.

When completed, this tunnel will be provided with a system of intense illumination by sodium vapor lamps. This intensity will be controlled by the "electric eye," which will insure maximum intensity in the brightest time of the day and less intensity on dull days and at night. There are a number of reasons for this seeming paradox. First, the tunnel extends in approximately an east and west direction. On bright days, the sun is in the eyes of east-bound traffic during a considerable portion of the forenoon, and of the west-bound traffic in the afternoon. The effect of the driver upon suddenly entering the tunnel would be to partially blind him, until his eyes could accustom themselves to the change, resulting in a hazardous tendency to hug the middle of the road.

Another reason is that there is a curve on a 250 ft. spiral at the east end, which will prevent drivers from seeing through from end to end. Therefore, on brightest days intense illumination will eliminate the "slap in the face" effect upon entering. As dusk comes on, and on dark days, when the pupils are not contracted from looking in the direction of the sun, the illumination will be toned down. At night, when headlights can be depended upon for most of the illumination, the lights will be lower still. While the electrical details have not as yet been completely worked out, the whole intent will be to produce as little change as possible, from the optical standpoint, in entering and passing through.

Dimensional Details.—The tunnel will have a total height of 21 ft. 7 in. with radius of 17 ft. from the springline. The width of 34 ft. provides for a 26 ft. highway with 4 ft. sidewalks on each side. These are inside finished dimensions. Outside is a 1 ft. reinforced concrete lining. As mentioned, the length is 827 ft. There is a 2° 30-inch curve at the east end, with a 4 per cent grade in through the tunnel and a vertical curve of 1600 ft. radius on the west.

Nature of Rock.—This presents considerable variety, though it is largely basaltic in origin. At the west por-

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tal is a variety of dice, though not a true dice rock. There is also a stratum of a more solid character that dips down across the face in a large portion of the tunnel at an angle of approximately 50° from the horizontal. At the left side of this stratum, looking at the east face, the rock is diced and breaks small. The center stratum is hard, block basaltic and breaks large, while below and to the right it is shattered and rotten rock, with mud seams and pockets.

"Timbering in Advance."—One of the first things to be done was to construct a bridge above the east portal (Fig. 1) to enable the old highway to carry the traffic



Fig. 3—Method of Setting Arch Ring Timbers Above the Rock Core, Which Was to Be Removed Later.

during construction, as part of the old roadbed would be cut out when the east portal was faced up. This bridge consisted of a 90-ft. timber truss, the deck of the bridge being 52 ft. above the bottom grade of the tunnel.

Before drilling could be started across the entire face in the west portal case, the nature of the material, which was not self supporting, called for timbering in advance of excavation of the core, for a considerable distance in from the portal at the west end. First side drifts and top heading were driven in 30 ft., the side drifts being to a depth and width sufficient to put in the concrete foundation footing of the side walls. This foundation also served to support the timbering.

From the heading, the arch was then ringed out and one set of arch timbers put in place, 30 ft. from the face, the plan being to start at that place and back out to the portal with the timbering. The entire arch ring was taken out in this way and timbered before the center core of the bore was taken out. The timbers were 12 in. by 12 in. with two plump posts and nine 6 ft. segments, all 12 in. by 12 in. Spacing was 3 ft. and 4 ft. c-c; 4 by 12 collar braces used; lagging 3 by 12; fir blocks and cordwood packed behind lagging. This procedure is best shown in Figs. 2 and 3 (west end). The former shows the breaking out of the arch ring at the outside face of the tunnel, while the latter shows the method of setting the arch ring timbers. In this case, the men are sitting on top of the center core of the tunnel to be taken out later.

Drilling and Blasting.—When the work had advanced into rock where timbering was no longer necessary, the contractor proceeded with Ingersoll-Rand 174 water liners to drill the entire face, and also load the holes, from a jumbo rig mounted on a truck and backed into the face. It was a two-deck structure, with framework of 3-in. pipe for mounting the water liners. Six could be employed at a time from the two platforms and the bottom of the tunnel.

Because of the character of the rock, the proximity of the Union Pacific railroad tunnel and tracks below, and the temporary bridge above the east portal, drilling was confined to 6 ft. length holes with light charges. This also reduced the amount of overbreak within the tunnel. Including the lifters, cuts and straight holes, 65 to 80 were drilled, depending on the condition of the rock. The explosive used was Atlas Giant Special gelatin, 40 per cent, and using Du Pont No. 1—No. 10 delay caps, fired 220 volts off the line. Tunnel Foreman W. R. Thomas stated that they were getting down about 1 to 1½ cu. yd. of rock per pound of explosive. In the drilling, they were getting about 2 ft. of rock per drill.

Little Shovel for Mucking Out.—In this work the adaptability of the small size shovel was demonstrated. One of the little Bucyrus-Erie 10-B's gave a good account of itself. In the narrow quarters of the tunnel, it could be run directly up to the down rock on one side of the tunnel and the truck backed in close beside it. Then, the short swing coupled with speed of manipulation more than made up for the small size of its ⅜ yd. dipper. Figure 4 shows the shovel at work inside the tunnel at the east end. In this case, it had been brought around from the west portal but a few minutes before, on its own special form of trailer hauled by a truck.

Service Facilities.— Compressor house, shop and a drill sharpening plant have been set up at the east portal. The compressors are two in number, being Ingersoll-Rand Imperial Type 40, driven by General Electric Type KT 346 single phase induction motors. Air from this plant may also be used on the west end, through a pipe line around the rock, to supplement the output of a Gardner-Denver portable Model AA Form 2002 compressor located at that point. For drill sharpening, an Ingersoll-Rand 44 drill sharpener is employed.

After the east face had been driven to a distance of 200 ft. or so from the portal, fumes from the blasting would no longer evacuate in reasonable time. A blower



Fig. 4—The Bucyrus-Erie 10-B Shovel Mucking in Tunnel at East End.

system was then installed. It consists of a B. F. Sturtevant 60 in. blower belt driven by a General Electric 25 h.p. single phase motor. This fan blows the air through a duct built of plywood, 3 ft. square in cross-section, to a point near the working face. The fumes are thus blown out of the tunnel rather than exhausted.

Tooth Rock Tunnel, when completed, will add one more feature to the varied and magnificent scenic effects of the famed Columbia River Highway. Coming from the East, the traveler will drive from bright daylight into the almost equally brilliant tunnel. Then, as he comes out of the West portal, the great Bonneville Dam with the striking architectural effect of power house, navigation locks and mighty spillway will come into full view for the first time, almost at his very feet.



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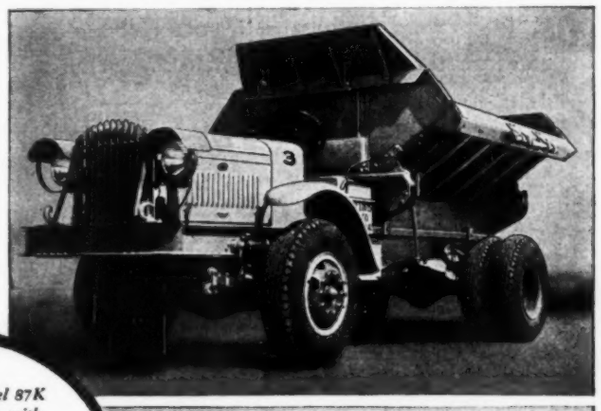
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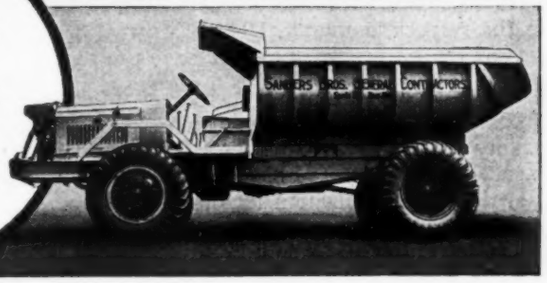


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● *At left: Model 87K Hug Roadbuilder with Hug 5-yard Excavation type body.*

● *At right: Model 87Q with standard 6-yard Hug Scoop-End body, U-shaped "I" beam side braces and equipped with high dumping angle power hoist.*



COUNTY ROAD ADMINISTRATION IN FLORIDA

By JOHN E. WALKER
County Engineer, Ocala, Fla.

ALL roads in Florida were under the jurisdiction of the boards of county commissioners, until the creation of the state road department in 1915, and all are now under their jurisdiction, excepting those roads in the state maintained system.

From 1915 to June 8, 1923, all state roads were designated and established by the state road department. The legislature of 1923 designated a system of state roads and each succeeding legislature has added to this system.

Roads designated by the legislature from time to time go into the state road system. But such roads do not leave the jurisdiction of the county until after the state road department accepts the same for construction or maintenance.

According to the last biennial report of the state road department the state system now has 11,142 miles, the state maintained system 6,543 miles and the county roads systems 20,201 miles of road.

County Commissioners

Under the law reading, "The County Commissioners of this State are hereby invested with the general superintendence of the public roads within their respective counties, etc.," each board of commissioners has set up a county road administration of its own.

The county boards are composed of five members, who are elected by the people, one from each of the five commissioners districts of the county.

Road Administrative Systems

There are three road administrative systems in the state.

The District System—Under this system each commissioner's district has a maintenance organization, making five separate and distinct units in the county. These units are usually headed by an overseer, or superintendent, reporting directly to the commissioner of the district. In some instances the unit is supervised directly by the commissioner of the district.

The Trustee System—This system exists where the county has a special law forming a board of trustees. The board is formed by a membership of three elected by the people. The board has jurisdiction of all roads in the respective county. There are two or three counties of the 67 in the state that have this system.

The County Engineer System—This system is in effect where an engineer is employed by the board of county commissioners to head the county road department. Usually under this system district lines are lost and the one organization handles the whole of the construction and maintenance of the county road system. Most of the larger counties work under this system.

Finances

Road Construction—The board of county commissioners is authorized by law to issue bonds to construct roads when approval is given by a majority vote of the free-holders of the county.

The state is prohibited by its constitution from bonding for road construction. This being the case, state road construction was very slow for the first few years after the creation of the road department. From 1915 to 1923 the state road department funds were very limited, a good portion of them being funds turned over by counties to be expended under supervision of the department on state roads within the respective counties turning over the monies.

Beginning in the early 1920's, and on through the "Florida Boom Period," practically all the 67 counties of the state bonded very heavily for road construction. A great part of the state road system was financed by the counties.

The state road department has taken over extensive mileage of these roads and included them in the state maintained system, but the counties still have the bonds to meet.

In 1923 the first gas tax of 2 ct. per gallon was authorized. Each succeeding legislature has changed and added to this tax until today we have a 7 ct. state gas tax. This tax is divided as follows: 3 ct. to the state road department, 3 ct. to the counties to apply on their bonded indebtedness (funds handled by a state board), and 1 ct. to the state general revenue fund.

This last division of the gas tax monies came when the counties began to default on bonds and could not meet payments of same. The automobile license tax law, known as the five, ten and fifteen dollar law, goes to the schools.

County Maintenance Fund—The boards of county commissioners are authorized to levy an ad valorem tax not to exceed 10 mills for road maintenance purposes. This is the only source of revenue for county road maintenance purposes, excepting that some of the counties apply the revenue they receive from the race track law to the road maintenance fund. The race track monies are turned over to the counties by the state to be used for any purposes.

▼

SHUT-DOWN STRIKE PROTESTS CITY GAS TAX.—A shut-down strike in protest against the city one-cent tax on gasoline, which became effective last December, was staged by the retail gasoline dealers of Tampa, Fla., during the last week of January. The strike, the first of its kind in the United States, lasted about a week, and at one time only four of the 150 stations in the city were open. The tax has not yet been rescinded.

▼

NO COUNTY GAS TAX IN TENNESSEE.—Counties in Tennessee on the north and Georgia on the east do not levy taxes on gasoline, and many motorists purchase supplies of motor fuel in the neighboring lower-tax states to escape the 3 cent Jackson County tax.



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EDITORIAL

Watch What You're Doing

MY wife wants a fur coat; I want a new suit; Skipper wants a pair of skates and a new dress; and Cap wants an electric train set. Our income is definitely limited, even as the income for highway work of a state is limited. In maintaining our home as a going concern we have milk bills, grocery bills, meat bills, fuel bills, doctor's bills, house payments, car installment payments, and the myriad other expenses to meet regularly. We're only an average going concern.

In order to keep the credit of our "home company" in a favorable condition we must so control expenditures that they stay within our income. Control of expenditures is based upon a very exact knowledge of existing facts, existing requirements, and near future demands. Were we to attempt to satisfy our wants it would be probably a matter of only a few days before we would find that our going concern was over extended, our credit eliminated, and a big debt burden on our hands. In fact, we might even expect a call from the sheriff.

Our going "home concern" is not different basically from a state. Of course, the state income for highway purposes is obtained differently, but the administrators of that income have the same type of problems that we have in our "home concern." Different entities of the political family want things, roads, bridges, signs, repairs, culverts, and equipment or materials. The highway income, though, is definitely limited. Were the highway commissions to enter into a spending spree which overshadowed their income it would not be long before they would find all avenues of credit closed to them.

In order therefor to know how most economically and most judiciously to spend their income they must have knowledge of existing facts, existing requirements, and near future demands. Right here is where the State Highway Planning Survey functions to excellent advantage. Take Indiana as an example.

There are many otherwise well informed Hoosiers who do not, even now, correctly understand the problems of their state highway commission. First of all, Indiana must provide for its fixed expense which includes payments on bond principal and interest, funds for maintenance, administration and certain unavoidable construction expense relating to the reconstruction of old bridges and worn-out surfacings. The principles of highway economics require provision for additional highway facilities arising through growth and development in population, business, and transportation. Recognizing this fact, the Indiana legislature two years ago created the Indiana Highway Survey Commission and provided it "shall make, or cause to be made, a scientific study and survey of the traffic needs and requirements of this State, shall investigate the desirability or necessity for widening the roads in congested areas, for highway and railway grade separation, for the repair, construction or maintenance of existing highways, and shall formulate a complete highway building and maintenance program for this State, and shall make recommendations relative to the means of financing the same. The Commission shall make a thorough study of the engineering, economic and practical problems involved and shall submit a report embodying their recommendations and program to the 80th General Assembly."

This Commission has reported.

After their field work had been underway for several months, the U. S. Bureau of Public Roads presented standards which they recommended for adoption by all States engaged in similar surveys in which Federal Aid was provided in part. The Commission followed the standards, supplementing them with additional material. Following are their recommendations regarding legislation to be prepared and presented to the present legislature:

1. That there shall be no diversion of any of the gasoline tax, fuel oil tax, weight tax, and license fees from highway purposes.
2. That there shall be no vehicles exempted from payment of the weight tax.
3. That all money collected for the Motor Vehicle Highway Fund shall be budgeted for maintenance, cleaning, reconstruction, repair and construction.
4. That funds budgeted for maintenance in a county shall not exceed in dollars the product obtained from multiplying the average maximum 24-hour traffic load on the county highway for that county by a factor of 1.20; that funds budgeted for maintenance of the state highways shall not exceed in dollars the product obtained from multiplying the average maximum 24-hour traffic load on the state system by a factor of 0.60; that any balance at the end of the year shall be transferred to the construction fund for the following year.
5. That funds expended for construction and betterments by the counties shall be under supervision of the State Highway Commission, in the same relation as the state highway is supervised by the United States Bureau of Public Roads.
6. That the State Highway Commission shall take over the maintenance and construction of all state and federal routes through cities and towns except the city of Indianapolis.
7. That the State Highway Commission shall add within two years a minimum of one thousand miles of county highways to the state system and may increase the state system to an extent that the total state highway mileage will not exceed twelve thousand miles, such extensions and additions to be made where the traffic count thereon is at least two hundred vehicles per day.
8. That the counties shall be permitted to issue revenue bonds for construction, such bonds being a lien only upon the funds allocated to the county for construction and that the bond moratorium of 1932 be extended to July 1, 1939.
9. That two million dollars shall be distributed to the cities and towns on the basis of motor vehicle registration.
10. That after deducting two million dollars from the

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BITUMINOUS AIR CELL EXPANSION JOINTS for BETTER PAVEMENTS



A new SERVICISED development: the Arm Dowel Supports provide rigid holders for the dowel bars and keep them in perfect alignment.



Short section of Metal Sided Expansion Joint riveted to Air Cell Joint, the rivet acting as dowel hole.



Two-Piece Bituminous AIR CELL Expansion Joint

Illustration shows cross section of this new development which insures proper installation and a smooth pavement.

Air Cell Expansion Joints, as engineered by Servicised Products Corporation are increasingly favored by highway engineers. They provide non-extruding joints with maximum allowance for compression — they are rigid and easy to install.

Servicised Air Cell Expansion Joints are made both metal and asphalt sided, with arm dowel supports and wired supports. Riveted dowel hole construction ensures the ease and accuracy of one-piece handling. Ask for our latest Bulletins.

SERVICISED PRODUCTS CORP., 6053 W. 65th ST., CHICAGO, ILL.

Yes—We would like you to mention ROADS AND STREETS

motor vehicle highway fund, one-third of the net balance be allocated to the counties so that six tenths of the one-third will be on the basis of vehicular miles of traffic and four-tenths of the one-third will be on the basis of registration of motor vehicles; and that whenever a county has a first class city the share of that county shall be divided in the proportion of two-fifths to the county and three-fifths to the first class city.

11. That the weight tax shall be paid on the basis of tire equipment.

12. That the State Highway Commission shall be permitted to acquire land adjacent to right-of-ways for roadside parkway development.

13. That the State Highway Commission shall be permitted to expend funds for the construction of sidewalks in certain localities.

14. That the State Highway Commission shall be permitted to participate in the construction of railroad warning signs on the same basis as the federal government is now participating.

15. That the motor vehicle laws be amended so as to fix the maximum gross weight of single vehicles or combination of vehicles at an amount not in excess of forty thousand pounds.

If one division of Indiana's political family wants a fur coat, highway administrators are now in a position to determine from factual data whether or not the fur coat expenditure should be made. They have accurate information to guide them in deciding how much should be allowed for groceries, milk bills and car payments, as it were. To the average layman, however, it seems to appear to be a matter that should immediately and could readily be solved.

As Mr. Fred J. Grumm, California Division of Highways, states, "There is need for caution in the adoption of practice or policy that involves sweeping changes in design. Relocation and new construction can be undertaken to advance the status of a State system in an orderly manner if work is laid out not only for the maximum immediate returns on the investment, but also for the future. In building State highways on a preconceived plan of balancing advantages throughout the system and of weighing values on investments, so much modern improvement has been accomplished and so much intrinsic value obtained on existing roads and so many potential advantages and economies depend upon consistent procedure, that any radical innovation should be adaptable to the improvements now in place and to the policy of equalizing service in all roads.

"Neither the engineer, the administrator, nor the public that pays the costs would consider that absolute necessity warrants the immediate raising of sufficient funds to satisfy all demands. There is no doubt that the engineer is able to design properly, if the cost of constructing such design can be supplied. The immediate problem is to create a design commensurate with the facilities now in place, with each project in relation to the problems on the whole system, and with funds now available for construction and maintenance."

▼

It Is Now Time for Efficient Construction

FOR several years back, emphasis in public construction has been placed anywhere but on economy, and with this fact we shall not quarrel. Emergencies may justify many things which normal conditions do not.

But it is now four years since grand scale job-making was commenced as an end in itself, and it is rank economic fallacy to continue it without regard to efficiency. Many jobs must be "provided" for a long time to come, but the work should be arranged to give a reasonable return for the expenditure. To say that this is too great a task for modern planning and management is to admit (to the joy of misanthropes and cynics) that our technical advance has outrun our business capacity, and that the next few generations must accept reaction instead of progress.

Nonsense! The thing can be done. But that is by no means to say it will be done. Capacity is no guarantee of fulfillment. To avoid the danger we must exercise courage and energy as well as intelligence—and plenty of all three.

It seems the veriest common sense that the end can be accomplished only by increasing the number and size of projects to the point where they will provide the necessary jobs when conducted efficiently.

Certainly we would not imply either simplicity or quick fulfillment of such a task. Our whole point is that there should be no more dallying. The tremendous work of planning and financing should be pushed with energy, until the necessary employment on an efficient basis is secured.

There seems no alternative to Federal leadership and assistance in this undertaking, but in the highway field the actual carrying out must be done largely by the States. County and municipality participation must be arranged with the rest, and from start to finish, cooperation of the highest order will be necessary. And this means not only cooperation of public bodies, but of private industry and business as well.

Or shall we except the cynics, "I told you?"

▼

Standard Signing

IN November, 1935, a joint committee of which Mr. E. W. James, U. S. Bureau of Public Roads, was chairman, produced a Manual on Uniform Traffic Control Devices for Streets and Highways that was approved as an American standard by the American Standards Association. Certain it is that our highway signing should be standardized. After standardization is adopted, budget allotments should be made to get the signs installed.

Since this manual was published an engineer of one of the state highway departments made a survey to determine what was being done at present. Remarks were included which indicated there was not complete agreement with the uniform standards adopted. If this is the case, then it appears that disagreements should be ironed out immediately, before the states make big investments in signs. Signing, generally, is poor. However, let us have reasonably complete accord before we spend good money for a sign that is not proper. We are not at liberty to quote disagreements or to discuss controversial points at this writing. We know they exist and believe they should be settled before states launch into signing programs. Members of the committee who drew up the standards are not now in complete accord as regards making changes.

Let's have as nearly unanimous approval as possible and then get the signs up.

NEW EQUIPMENT AND MATERIALS

Le Tourneau Announces Expanding Scraper

A new carryall scraper to be manufactured in four capacities and called the Type U expanding carryall has been announced by R. G. Le Tourneau, Inc., Peoria, Ill.

This scraper, with the exception of its bowl, is similar in design, construction and operation to the 1500 carryall scrapers that have preceded it and are now in operation the world over. Its bowl consists of two buckets, the rearmost of which telescopes within the forward bucket. When loading, this rear bucket fills and is then carried back by a return spring, thus expanding the bowl capacity and increasing yardage 50 per cent.



Le Tourneau Model U Expanding Carryall Scraper

In common with other Le Tourneau carryall scrapers, the Model U is cable controlled by means of a two-drum power control unit mounted on the tractor which draws the scraper. Both the front apron and the tailgate can be manipulated through the power control unit to facilitate loading. The patented sliding tailgate forces all material, regardless of stickiness, out of the bowl. The high apron lift gives ample clearance for loading and unloading rocks and bulky material.

The four sizes manufactured are 18-yd., 12-yd., 9-yd. and 6-yd. The 18-yd. operates singly or in tandem behind an RD8 tractor, the 12-yd. behind an RD7, the 9-yd. is powered by the RD6 and the 6-yd. is powered by the RD4.

Chief revolutionary feature of the U models is this: the U18 has the same cutting width as the former 12-yd., but due to its big tires and expanding bowl, loads extra yardage with virtually no extra tractor effort. Similarly, the U12 and U9 have cutting edges equally respectively to the 8-yd. and 6-yd. carryalls.

New Portable Crushing Plant

A new portable crushing plant both for coarse crushing and for fine reduction has been developed by the Smith Engineering Works, Milwaukee, Wis. Where specifications permit the use of coarse rock (1½-2½-in. sizes) the Telsmith portable unit may be equipped with a Telsmith primary breaker, sizes 6-B or 8-B. Such an outfit will deliver 1½-in. or 2-in. rock in large tonnages. Where finer sizing is required, the same outfit may be equipped with the No. 32-B Telsmith reduction crusher, an ideal equipment for the production of ¾-in. or 1-in. aggregate in large capacity. Where ¼-in. to ⅝-in. aggregate is specified, Telsmith recommends the No. 240 equipped with the No. 24 Gyrasphere. Between these extremes there is a wide range of service which is spanned in liberal fashion by the Telsmith wheeling jaw crusher.

In the Telsmith portable unit the crusher is in closed circuit with a bucket elevator and vibrating screen. No product can escape from the circuit to the finished product conveyor until it passes the screen. Standard unit is designed to deliver only one finished size, but this single product may be reclassified into several grades by installation of a screen over the storage bin.

Telsmith has recently issued a new bulletin No. 265-B which describes their portable plants in detail and it may be secured by writing direct to the Smith Engineering Works, Milwaukee, Wis.



New Telsmith Portable Unit in Operation in Mexico

Auxiliary Transmission for Trucks

Development of an auxiliary transmission especially adapted to service in trucks that haul sand and gravel or other road materials has been announced by H. S. Watson Co., San Francisco. This transmission gives to the truck a series of underdrive gear ratios in addition to the usual four standard speeds. It is a 2-speed underdrive and direct auxiliary that adds 4 speeds or gear ratios forward, making a total of 8 speeds plus 2 reverse.

The unit is called the Watson-Brown-Lipe auxiliary transmission, Model 2322. It may be installed in trucks from 1 to 10 tons with engines up to 190 foot pound torque. The underdrive gives a ratio of 1.96 to 1.

In addition to the standard speed changes it offers a low-low, low-second, low-third and low-high. When pulling up steep grades or out of a bad hole or traveling along unimproved roads, the extra ratios are claimed to enable the operator to select exactly the proper gear ratio for the condition. The unit is installed behind the factory-equipped transmission. It can be salvaged and used in other trucks.

A bulletin describing the auixiliary may be obtained from the manufacturers, H. S. Watson Co., 1145 Harrison St., San Francisco, Calif.

New 6-Cylinder Diesel Power Unit

A new addition to the line of power units of the International Harvester Co., 606 South Michigan Ave., Chicago, Ill., is the Model PD-80 six-cylinder Diesel unit shown in the accompanying illustrations.

As is the case with other International Diesel engines, the PD-80 power unit is provided with a distinctive system of starting by which the engine may be converted into a conventional gasoline engine at first to facilitate starting. Thus the engine may be started by cranking as readily as a gasoline engine of corresponding size.



New International Diesel Unit at Work on Crusher Plant of Joplin & Eldon, Contractors

The seven-bearing crankshaft is of chrome-molybdenum steel. The seven main bearings and connecting-rod bearings, all of which are replaceable, are steel-backed and copper-lead lined. The special alloy, heat-treated cylinders are also replaceable.

Regular equipment for the PD-80 includes fuel injection pump, fuel supply pump, closely regulated governor of the fly-ball type, fuel filters, full pressure lubrication with gear-driven oil pump and double capacity metal oil filter with oil pressure regulating valve, International carburetor and International high tension magneto (with automatic impulse starter coupling) used for starting purposes only, exhaust pipes, and mounting angles. Equipment that does not need to be purchased unless it is desired for the job includes such items as clutch unit and throw-out mechanism and belt pulley shaft, radiator and fan, hood, hood size doors, oil-type air cleaner, and welded steel base. Available as special equipment are an electric starter and—for irrigation pumping—an automatic shut-off for the cooling water, a front hood sheet used in place of the radiator, and an oil filter with a shut-off to permit cleaning the filter while the engine is running.

Maximum horsepower of the International Model PD-80 fully equipped and corrected to sea level barometric pressure and 60 degrees Fahrenheit is 100; the horsepower under continuous load (80 per cent of maximum horsepower) is 80. Bore and stroke of each cylinder are respectively 4¾ and 6½ in. Clutch diameter is 15 in. and clutch torque, 785 pound-feet. Overall length, including starting crank but not belt pulley, is 98¼ in.; overall width (24-in. turning radius of starting crank not included) is 41 in.; and overall height on welded steel base is 66¼ in. Approximate weight fully equipped and including base is 3750 lbs.

▼

Two New Graders

Two new blade graders, in 12-ft. and 10-ft. sizes, have been added to the grader line of the Caterpillar Tractor Co., Peoria, Ill. These new models have single member frames and will be known as No. 66 single frame and No. 44 single frame, since they are in the same weight classes as the No. 66 and No. 44 double frame models. They are offered in both power and hand control.

These new machines are designed particularly for combination work in which quick movement of the blade from ditching position to the high rank cutting position is important. With the power controlled models less than one minute is required to move the blade from one of these positions to the other, and with any of the models this may be done without offsetting the blade on the blade arms, or making any changes in lifting or lateral shift links.



Caterpillar Diesel RD7 Tractor and Power-Controlled Blade Grader at Work on Road Construction Near Peoria, Ill.

The single frame models have the same strength and durability, precision made parts and ease of operation that have made the No. 66 and No. 44 double frame graders such popular and fast selling machines.

The single frame members are made of two ship channels, 9 in. on the No. 66, and 8 in. on the No. 44. These two channels are about 4 in. apart in the center, and a steel plate is welded over the top and bottom of both channels, forming a box type frame member, about 11 in. wide with great strength and rigidity.

Immediately back of the blade arm mounting, the frame channels separate and form two members, each a box section having plates welded between the channel flanges. This construction provides unusual frame strength, yet does not obstruct blade visibility. Both blade lift links are of the telescopic type and may be quickly extended for securing the most extreme blade positions for unusual jobs.

Light Weight Pump and Generator

Large power capacity combined with unusual portability, are claimed for the 650-watt generator and the 3-in. self-priming pump brought out by the Homelite Corporation of Port Chester, N. Y.

The generator weighs only 71 lbs. complete with built-in gasoline engine, and can be easily carried by one man. Quick-starting action even under severe weather conditions is claimed by the makers. The air-cooled engine is said not to freeze, flood or overheat. Voltage is automatically maintained at 110 volts regardless of load variation.

Weighing only 93 lbs., the self-priming pump can be moved quickly to jobs. It is stated to handle 15,000 gal. per hour of thick, muddy water. It is also stated to have a guaranteed suction lift of 28 ft. A high tension, waterproof magneto promotes easy starting under all conditions. Both the pump and generator are completely weatherproof and dustproof. A 2-in. pump and a 1250-watt generator are also available.

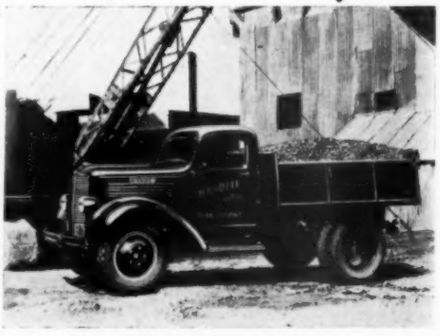
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New Dodge Trucks

Featuring still greater economy, numerous mechanical improvements and a brand new capacity model, the Dodge division of Chrysler Corporation has introduced its 1937 series of trucks and commercial cars. The new line includes one-half ton, ¾-1 ton, an entirely new capacity model, and one and one-half, two, three and four ton trucks.

Important mechanical advantages of all the 1937 Dodge trucks include such features as greater engine power, hydraulic brakes, fuel lines mounted on the outside of frame, improved ventilation of fuel pump to reduce possibilities of vapor lock, outside gasoline filler tube on cab models, longer rear springs, and stronger safety steel cabs.

The 1937 2-ton model has a gross weight rating of 13,500 lbs. and is available in wheelbase lengths of 133 in., 148 in., 159 in. and 177 in. The engine used in this model has a 3⅜-in. bore and 4½-in. stroke and a piston displacement of 241.5 cu. in. It develops 175 foot pounds torque and 85 horsepower. The rear springs on this truck have been increased 4 in. in length. The heavy-duty 11-in. clutch with torsional damper on this model now has a self-



The New 1937 Dodge 2-Ton Dump Truck. This Truck Is Equipped with a Hydraulic Lift

lubricating ball bearing clutch release. A full-floating rear axle is offered in ratios of 5.125 to 1, 5.66 to 1 and 6.33 to 1. Available as extra equipment is a double reduction axle with a ratio of 7.35 to 1, also a two-speed axle with ratios of 5.142 to 1 and 7.15 to 1.

Booster-operated hydraulic brakes that are 16 in. in diameter and 2½ in. wide are featured as standard equipment on this model.

▼

A New Type of Road Maintainer

Perfect maintenance at extraordinary speed and very low cost is the manufacturer's outstanding claim for the machine here pictured. A 1½ ton truck is considered to be the ideal tractive unit, although a heavy passenger car has been used successfully where other power was not available. In transportation the blades and runners are lifted 16 in. from the road surface.

In operation the maintainer travels entirely on the runners, to which the blades are adjustably connected by hydraulic cylinders. This eliminates all irregularities resulting from maintainer wheels dropping into holes or depressions, and makes possible a complete job in one trip instead of two, as is often necessary.

This maintainer is strictly a one-man machine, and requires no operator in addition to the truck or tractor driver.

An interesting feature is the automatic blade adjustment through drawbar pull. This makes it unnecessary for the driver to shift the lower speed when he encounters more material than the normal for which he has set the machine. When the pull increases due to excess material, oil is released from the blade control cylinders on the side, allowing them to raise slowly without disturbing the fixed setting for crown wanted. As the surplus material slowly filters out from the blades, the drawbar pull decreases, thereby forcing the blades to return to their former setting.

Another feature is a blade adjustment for removing oversize stone. When set for this purpose, all finer material passes under the blade, while the oversize is carried to the side and dropped. If desired to remove the large material still farther from the road surface, a special device known as a "stone thrower" may be attached. This will cast the objectionable pieces from 10 to 12 ft. to the side when the maintainer is operated at between 12 and 15 miles per hour.

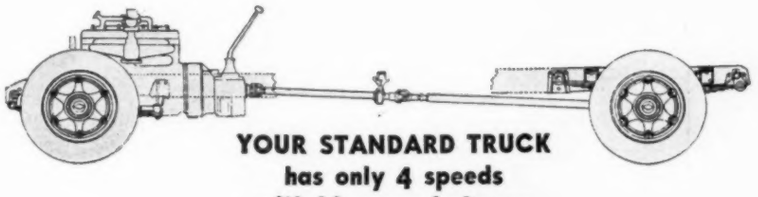
The manufacturer, the Allen Road Machinery Co., Shreveport, La., states definitely that this maintainer is not intended to replace heavy construction equipment, but that it is made for the express purpose of putting roads in good condition in minimum time. Thus it takes maximum advantage of the comparatively short periods during which roads are in their most workable condition.



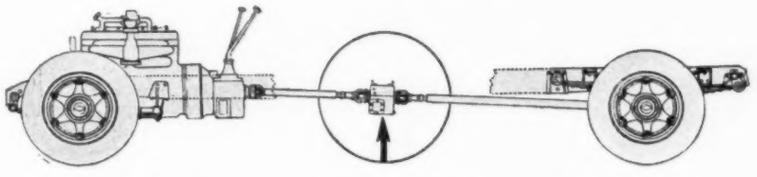
The Allen Road Maintainer

FILL THE GAPS
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YOUR STANDARD TRUCK
has only 4 speeds
with big gaps between



SAME TRUCK WITH A W-B-L AUXILIARY
has 8 or 12 speeds, with all gaps filled in

TRUCK engines are severely handicapped unless the power is properly ratioed through the driving wheels. By installing a Watson-Brown-Lipe Auxiliary Transmission you fill the gaps. You can select a W-B-L 2-speed unit which gives your truck 8 speeds Underdrive and Direct or a 3-speed unit which gives 12 speeds, Underdrive, Overdrive and Direct. The Underdrive offers 50% to 100% more power.

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Overdrive
& Direct

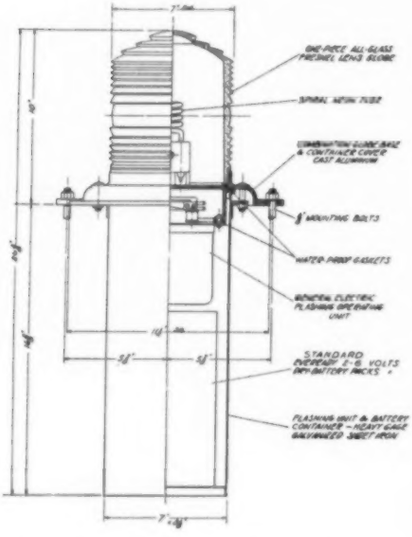
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Neon Flashing Beacon

The U. S. patent office has just allowed a patent on an unusually interesting dry-battery operated Neon flashing beacon, manufactured by the Municipal Street Sign Co., Inc., under the trade mark "Municipal."



Assembly of Flashing Neon Beacon

The Neon flashing beacon can be furnished as a complete unit and adapted to be used in conjunction with the customer's own pedestal, or can be furnished complete, including cast iron pedestal. It is also designed to replace any other type of beacon head now in use.

There are no moving mechanical parts in the flashing operating unit.

The flashing light is stated to penetrate fog and mist and is arranged to produce an unusually "long vision" sustained flash, thereby increasing visibiltiy at a great distance.

Full information may be obtained by writing to Municipal Street Sign Co., Inc., 235 Meeker Ave., Brooklyn, N. Y.

▼

New 2-HP. Air Cooled Engine

The Novo Engine Co., Lansing, Mich., is now manufacturing a streamlined air cooled engine. It is a 2 HP. engine that is streamlined for the most efficient flow of cooling air over the head and block as well as for graceful lines giving eye appeal. This engine is the Model A-16.

Extreme care in design has resulted in exceptionally light weight per horsepower developed—net weight only 97 lb. The compact design gives small mounting dimensions, 10x10¼ in. For light weight and added strength, a new type pressed steel connecting rod is used in these engines.

An interesting feature of this engine is the protected position of the carburetor which is tucked away behind the heavy steel end plate, eliminating the possibility of bumps or knocks from injuring this piece of mechanism. The magneto is a flange mounted standard rotary type with impulse coupling. To facilitate ease in starting, the engine is cranked off the cam shaft which spins the engine at double engine speed. The impulse coupling gives a hot spark for starting.



Model A-16, 2 HP. Engine.

Before You Buy Any

Bituminous Distributor

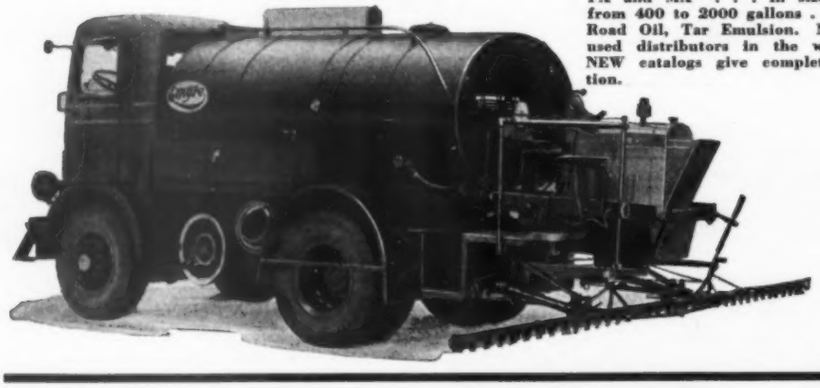
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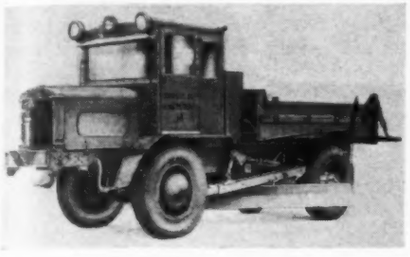
Branches, BOSTON, NEW YORK CITY . . . Dealers in Principal Cities.

Yes—We would like you to mention ROADS AND STREETS

Three New Maintenance Units

Three new maintenance units—the hydraulic truck patrol, patch roller, and scarifier, have been brought out by the St. Paul Hydraulic Hoist Co., Minneapolis, Minn.

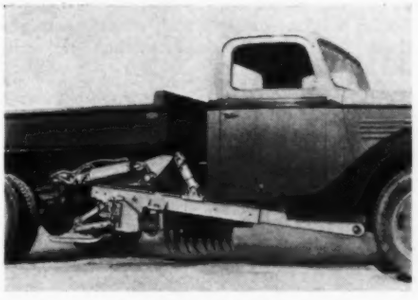
The hydraulic truck patrol is a cutting and levelizing mechanism, not a scraper. Its primary purpose is the reshaping and



Hydraulic Truck Patrol

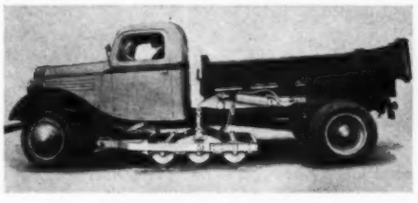
smoothing of rough roads. It fills in ruts and builds up road centers. Hydraulic power to the blade is furnished by a heavy duty pump, which is operated by a power takeoff attached to a standard opening in the truck transmission. The same pump can be used to operate the hydraulic hoist and dump body. Teeter, rock and jump of the blade is stated to be eliminated at all speeds through the combined action of the hydraulic ram and levelizer.

The hydraulic patch roller for motor



Hydraulic Scarifier

trucks is designed for the purpose of doing the final work of putting in a real road patch. Its rolling and kneading action packs bituminous material in the hole to be filled, making it level with the roadway and unnecessary to leave material higher than the road surface.



Hydraulic Patch Rooler

The patch is rolled out smooth by the application of hydraulic power to the rollers. Like the truck patrol, while not in use the roller is lifted by hydraulic action and carried high enough under the chassis frame to provide ample road clearance.

The scarifier can be used as an attachment for trucks equipped with the St. Paul hydraulic truck patrol, or installed on the chassis with complete hydraulic cylinder, pump and controls as a scarifying unit.

Southwest Carry Scraper Simplified

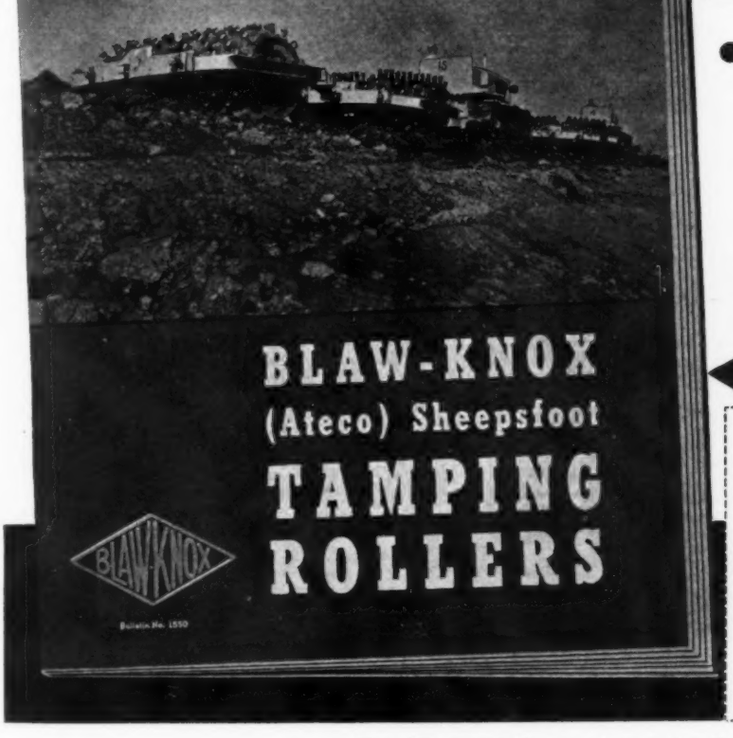
Production schedules are now in effect at Southwest Welding & Manufacturing Co., Alhambra, Calif., on a simplified design of the Southwest carry scraper. Capacities remain at 6, 8, 10 and 12 cu. yd.,



Southwest Carry Scraper

but the frame structure has been changed from the I-beam type to the welded box type, giving added strength with less weight, and eliminating projections for the accumulation of dirt. The important feature of the former design is the central pivot construction that reduces the power demand on the tractor, and, in the cable type, materially lengthens the life of the cables. This feature has been retained and improved.

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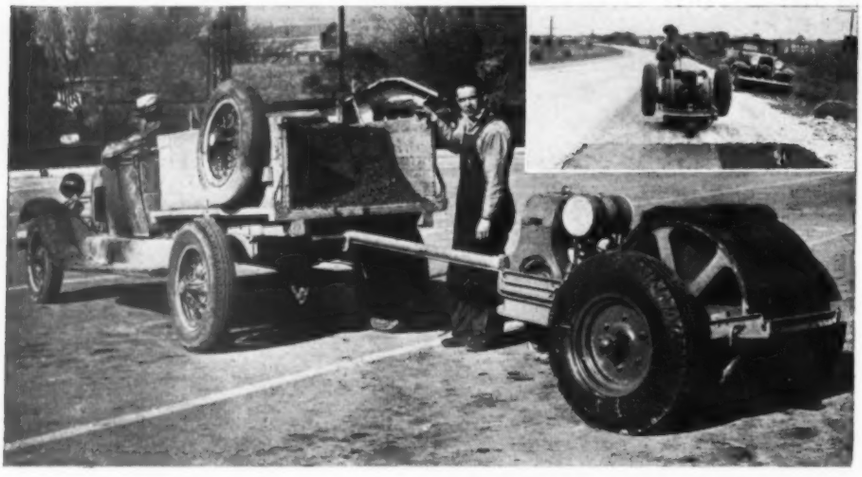
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Yes—We would like you to mention ROADS AND STREETS

New Power Roller

Ease of transportation, a capacity of 135 lb. per linear inch, a low selling price, and small operating costs are the main features claimed by the Wheeled Roller Corporation of San Antonio, Texas, for their new Wheeled Roller 135.

The truck which takes the men and material to the job takes along the roller as a trailer on pneumatic tires and Timken bearings. On the job, the operator lifts the tongue up and over to make the roller ready for operation. The roller travels either forward or backward, at a speed of from 1 to 2½ m.p.h. The drum is 24 in. wide and 32 in. in diameter and weighs approximately 3,250 lbs. The air cooled engine is mounted on an independent frame and is not turned with the main frame.



The Wheeled Roller Corporation's New 1935 Ready to Move. The Inset Shows the Roller in Operation

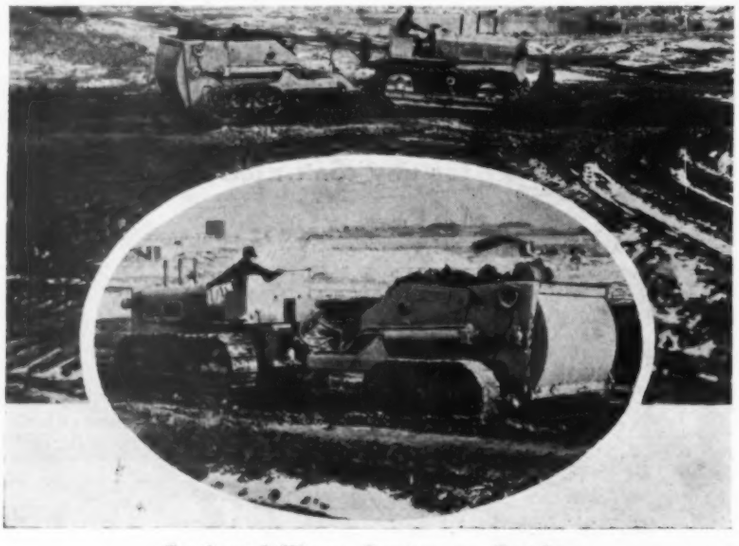
▼

Wagon Scrapers on Crawlers

The Tractor Equipment Division of the Continental Roll & Steel Foundry Company, East Chicago, Ind., announces a line of wagon scrapers mounted on crawlers. It is stated that the use of crawler units in no way affects the efficiency or speed of operation of Continental wagon scrapers and, in many cases, their use actually lessens the load on the tractor.

All sizes of Continental wagon scrapers—5, 7, and 10 yd. models, are available with crawler units; the 10-yd. unit being available for field replacement on Continental wheeled wagon scrapers now in the field.

Descriptive literature on crawler equipped wagon scrapers is available from the manufacturer at the address above.



Continental Wagon Scrapers on Crawlers

▼

National Traffic Appliance Company Introduces New Marker

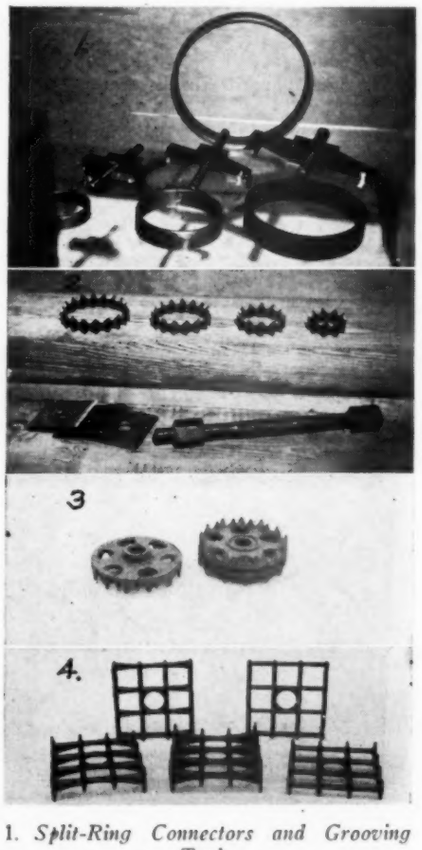
These reflecting traffic line markers appear as a line of electric lights down the center of the roadway to guide the motorist. They close when hit by the wheel of a vehicle, then open up again. A marker offers practically no obstruction to an automobile tire which might be driven over it. When closed they are only 1¼ in. high. They are constructed so as not to interfere with snow plows. They are not affected by snow or ice. They reflect in rain, snow, or fog. They are easily installed by drilling two holes from 1½ in. to 3 in. deep in the pavement, and setting the anchors in tar.

▼

Timber Connectors in Bridge Construction

New types of connectors introduced by the Timber Engineering Co., 1337 Connecticut Ave., Washington, D. C., have resulted in important changes in the design and construction of timber highway bridges. Connectors here shown include: Split rings in sizes 2½ in., 4 in., 6 in. and 8 in. in diameter; toothed rings in sizes 2 in., 2⅝ in., 3⅜ in. and 4 in. in diameter; shear plates 3⅛ in. in diameter and spiked grids 4¼ in. square.

Timber connectors are installed between the contact surfaces of timbers meeting at a joint and are held in place by means of machine bolts and washers. Their use makes possible the design and construction of timber highway bridges by methods closely approaching those familiar to all designers and erectors of steel bridges. Relatively small and short structural timbers may be assembled into



1. *Split-Ring Connectors and Grooving Tools.*
2. *Toothed Rings with High-Strength Rod for Embedding. After joint is drawn together, the rod is replaced by a common bolt.*
3. *Shear Plate Connector with Hub, Which May Be Used to Transmit Load to Either Wood or Steel.*
4. *Three Types of Spike—Grid Connectors.*

BAKER

The Bulldozers That Do Not Choose Their Jobs



There's a big difference in Bulldozers. Why not choose the kind that do not pick their jobs —the kind that are ready for any assignment.

Baker Hydraulic Bulldozers are built to handle any bulldozing job. They are simply and sensibly built. Less wasted power—more effective work. With strength to spare and long life, the up-keep costs are away down.

Direct lift—easy, fast operation—few wearing parts—no gears, springs, levers or cranks—correct mounting on the tractor—accurate performance—these are more reasons why there are *more Bakers on more jobs.*

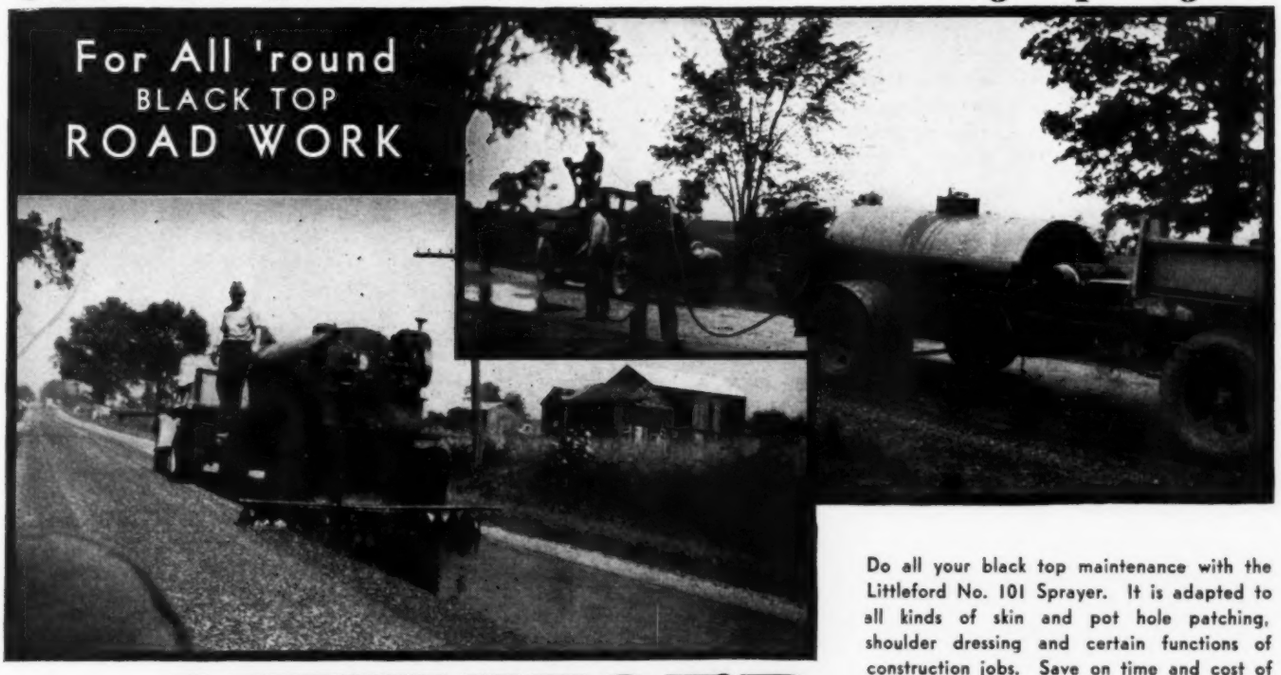
Ask for latest bulletins on Baker Bulldozers, Gradebuilders and other Baker products.

The Baker Mfg. Co.
506 STANFORD AVE.
SPRINGFIELD, ILLINOIS

Making Good Equipment Since 1908

BAKER TRACTOR EQUIPMENT
BULLDOZERS
GRADEBUILDERS
ROAD ROOTERS
TRACTOR SCRAPERS
ROAD DISCS
MAINTAINERS
SNOW PLOWS

Use the Littleford No. 101 Utility Sprayer



LITTLEFORD

Road Maintenance Equipment
SINCE 1900

THE SIGN OF A GOOD HEATER
LB
LITTLEFORD BROS. CINCINNATI, OHIO

LITTLEFORD BROS. 454 E. PEARL ST. CINCINNATI, O.

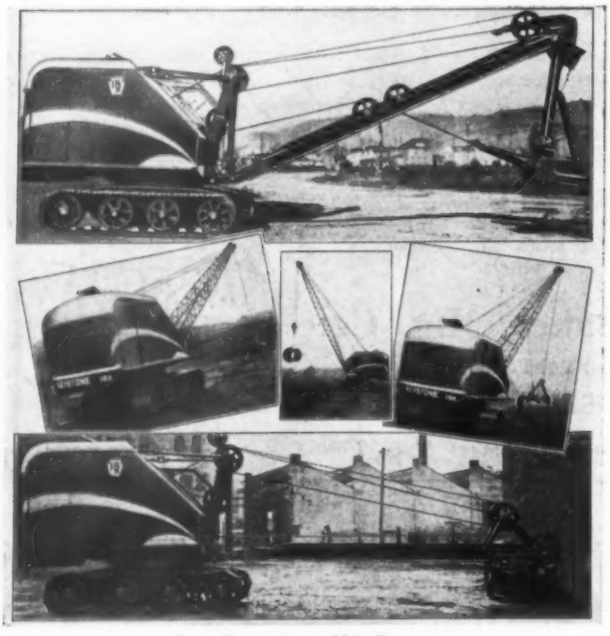
Do all your black top maintenance with the Littleford No. 101 Sprayer. It is adapted to all kinds of skin and pot hole patching, shoulder dressing and certain functions of construction jobs. Save on time and cost of materials by using bulk bitumen. Use this pump type machine to advantage for transferring or barreling material in your yards. The No. 101 is rapidly gaining favor, everywhere. Sizes 300 to 1,200 gallons capacity for truck, trailer or semi-trailer mounting. Write for complete information, now.

chords, posts and web members, so interlaced and connected at their joints as to result in a highly efficient use of structural timber and a corresponding reduction in cost. The Timber Engineering Company issues specifications for the design and construction of timber connector highway bridges.

▼

New Keystone 1-Yd. Excavator

Accuracy of control is claimed an outstanding feature in the new Model 18A one-yard excavator brought out by the Keystone Driller Co., Beaver Falls, Pa. The use of planetary drives and oversize clutches, designed for efficient operation in service necessitating constant slippage of the clutch for long periods of time, plus smooth, easy control with the same lever system which has always been so desirable in steam powered machines, are stated to be largely responsible for the greater accuracy with which the machine can be operated.



New Keystone 1-Yd. Excavator

The machine is built for a wide variety of digging, having one boom that is used in both trench hoe and skimmer service, and to which a short extension may be attached for short boom, crane service. The machine is also available with a boom for dragline, clamshell and crane.

By means of the oversize clutches and planetary drives for both boom swing and line movement, it is claimed to be possible to ease loads into position with great precision. Loads may be picked up as gradually or as quickly as desired and moved at the speed most practical for each kind of job. In close quarters the greater accuracy of control and short tail swing facilitate many operations.

Model 18A is powered by Buda engines, either gasoline or Diesel, or, if desired, by any standard make electric motor.

WITH THE MANUFACTURERS

International Harvester Promotions in Sales Department

Three managerial promotions in the sales department of International Harvester Co., Chicago, Ill., have been announced by C. R. Morrison, Vice-President. The changes are: the appointment of J. L. McCaffrey, former manager of domestic sales, as director of domestic and Canadian sales; appointment of W. F. McAfee, former manager of domestic motor truck sales, to succeed Mr. McCaffrey as manager of domestic sales; and appointment of P. V. Moulder, former assistant manager of the Eastern district, to succeed Mr. McAfee as manager of domestic motor truck sales.

Mr. McCaffrey began his service with the Harvester Company in 1909 at the Cincinnati branch as a warehouse clerk, later becoming the branch advertising man. In 1912 he was made a full-time motor truck salesman; in 1920, assistant branch manager; in 1923, assistant manager of the Central district; in 1925, manager of that district; in 1927, manager of the Northwestern district; and in 1930, assistant manager of domestic sales. His promotion to manager of domestic sales took place in 1933.

Mr. McAfee was first employed by the company in 1914 as a salesman at the Atlanta, Georgia, branch. In 1915 he became a blockman at the Jacksonville, Fla., branch; in 1918, assistant to the branch manager at Charlotte, N. C.; and in 1919, manager at Charlotte. He came to the Chicago office in 1922 to take charge of tractor, engine, and thresher sales, serving in that capacity until 1924 when he became manager of motor truck sales. Mr. McAfee is chairman of the motor truck committee of the Automobile Manufacturers Association.

Mr. Mouler started with the company in 1906 at the Chicago office as a messenger in the sales department. Clerical and secretarial posts followed until 1916 when he went to the Denver, Colorado, branch as a salesman, later becoming a blockman. In 1920 he was made assistant branch manager at Jackson, Mich. From 1922 to 1935 he served successively as branch manager at South Bend, Ind., and motor truck branch manager at Pittsburgh, Penn., Albany, N. Y., and New York City, after which he was appointed assistant manager of the Eastern district.

Gruendler Opens New Sales Zone

The Gruendler Crusher & Pulverizer Co. of St. Louis, Mo., in order to be in better position to handle its expanded business has opened up a zone with headquarters at Chicago, Ill. T. A. Oberhellmann is zone manager covering the north central states. His offices are at 205 W. Wacker Drive, Chicago. Leo Freeman will cover the southern states, with headquarters at St. Louis.

▼

Ralph S. Jenkins Named Vice President in Charge of Gar Wood Manufacturing

Logan Wood, vice president and general manager of Gar Wood Industries, Inc., has announced the appointment of Ralph S. Jenkins as the company's new vice president in charge of manufacturing of all its divisions. Mr. Jenkins came from Minneapolis, where he resigned as general manager of the St. Paul Hydraulic Hoist Co. to become associated with Gar Wood Industries, Inc.

In 1921 Mr. Jenkins became affiliated with the Wood Hydraulic Hoist & Body Co. (Gar Wood Industries' name at that time), when Gar Wood purchased the Horizontal Hoist Co. in Milwaukee. Starting as an assembly foreman, Mr. Jenkins' rise with Gar Wood was rapid. He was promoted from general inspector to assistant factory superintendent and finally to director of all the company's branches, a position which he held until 1932, when he left Gar Wood to become general manager of the St. Paul Hydraulic Hoist Co. in Minneapolis.

"Greatly increased business activities made it necessary for us to create a new position and vice presidency for the purpose of centering manufacturing responsibilities," stated Logan Wood.



R. S. Jenkins

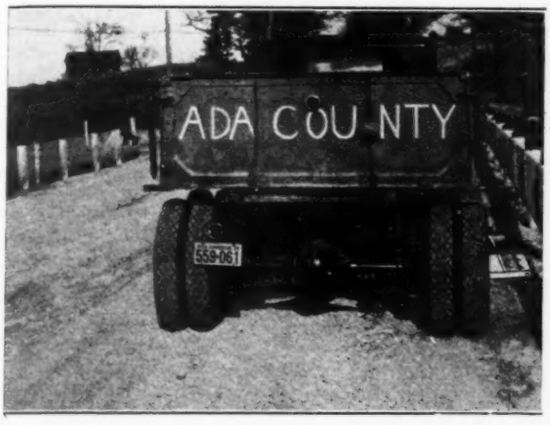
"Because of Mr. Jenkins' extensive experience and former association with Gar Wood, he is thoroughly familiar with factory policies and brings to Gar Wood Industries, Inc., a practical knowledge of present-day manufacturing methods and requirements."

▼

Work Progressing on American Rolling Mill Co. Research Laboratories

Erection of structural steel for one of the most unique industrial buildings in the world—new research laboratories for

Gravel and Earth Road Maintenance



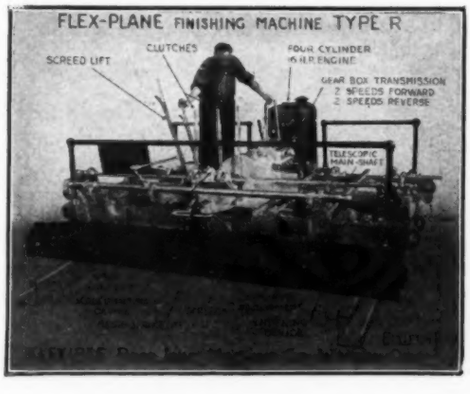
Now is the time to plan your maintenance program for spring. Select the up-to-date rapid motor truck method of whipping these highways in shape, and keeping them that way during the year—10 to 15 miles per hour operation—safe for present day motor traffic.

Not necessary to remove maintainer from trucks when hauling material. Fine for leveling dumped loads, etc.

Let us prove to your satisfaction that you can save over one-half maintenance expense with better results. Write or wire.

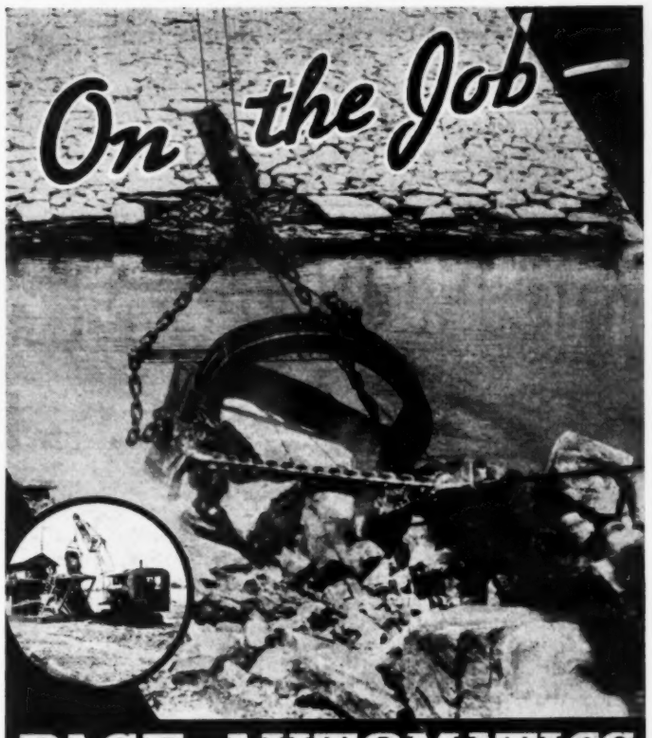
ROOT SPRING SCRAPER CO.
KALAMAZOO, MICHIGAN

"THE NAME FLEX-PLANE"



"Flex" signifies flexibility. "Plane" signifies plane joint. When used at close intervals, "Flex-Plane" joints form a road vertebrae. Use "Flex-Plane" joint installers for all contraction joints, also "Flex-Plane" finishing machines—there are none better. Write for complete information.

FLEXIBLE ROAD JOINT MACHINE CO.
WARREN, OHIO



PAGE AUTOMATICS
Prove they can Increase Yardage 20% to 50%

Users Report Their Results with the Patented Rounded Front AUTOMATIC:

*An Indiana contractor reports:
"Has increased our production at least 75%. To us, the Page Automatic is the only bucket for dragline work."

*An Illinois coal stripper writes:
"Last winter we purchased an 8-cy. Automatic. It has increased our yardage, enabled us to dig harder burden that we could not dig before."

*A gravel plant owner says:
"This bucket has speeded up our operation. It comes up with a full load when working under 15 feet of water."

*From letters in our files.

Hundreds of AUTOMATIC users in every state and five foreign countries are increasing dragline yardage and profits. Ask them of their results — then see your equipment dealer or write us direct for information on an AUTOMATIC best suited to your machine and job. Bulletin "The AUTOMATIC" gladly sent on request.

BUILT IN SIZES 3/8 to 15 CUBIC YARDS

"DIG WITH A PAGE AUTOMATIC"
Address: Dept. R

PAGE ENGINEERING COMPANY
CLEARING POST OFFICE - - - CHICAGO, ILL.

The American Rolling Mill Company—is practically completed at Middletown, O., officials of the company have announced.

Seven carloads of steel, fabricated from heavy rolled sections at The Austin Company's Cleveland shops, were rising on the site within five weeks after announcement of the project by Charles R. Hook, president of Armco. Steel was delivered to the job in sections to facilitate assembly.

The welded steel framework will be enclosed by an assortment of construction materials applying the results of long research by the steel and glass industries—porcelain enamel exterior panels, fabricated steel insulating panels and partitions, a perforated steel roof deck, stainless steel decoration and great areas of glass block. The building is being equipped for summer and winter air conditioning.

More than 100 rooms will provide laboratory, shop, conference, and office facilities for the company's major research activities. With a total area of 43,500 sq. ft., the project will cost about $260,000 exclusive of equipment.

▼

Fleming and McDargh Appointed Regional Managers P.C.A.

The appointment of E. M. Fleming as regional manager of its Eastern offices with headquarters in New York and the naming of H. J. McDargh as Southeastern regional manager, has just been announced by W. M. Kinney, general manager of the Portland Cement Association. Fleming has been district manager at New York since March, 1935. McDargh, who will make his headquarters in Atlanta, Ga., has been district engineer at Indianapolis since 1934. Mr. Fleming joined the staff of the association in 1926 and Mr. McDargh in 1924.



E. M. Fleming

Mr. Fleming's appointment fills a vacancy made by the resignation of J. R. Fairman as Eastern regional manager to join the Pennsylvania Dixie Cement Corporation.

Mr. Fleming before going to the New York office was manager of the association's Highways and Municipal Bureau. During his service as such he directed the association's concrete road condition survey of over 6,000 miles of concrete roads and was responsible for the construction of the Elmhurst cement bound macadam test road built by the association to get data on the best method of building this type of pavement. He has represented the association on committees of the Highway Research Board, American Society of Testing Materials, American Road Builders Association, American Concrete Institute, and other national technical organizations.

Prior to coming to the association he was associated with the Illinois Division of Highways. He is an alumnus of the University of Pennsylvania and is a member of the American Society of Civil Engineers.

Mr. McDargh joined the staff of the association in 1924 as a field man in the Indianapolis district. He was made office manager of the association's Columbus office in 1930 and transferred in 1931 to Chicago as assistant to C. D. Franks, manager of the Midwestern offices. He has been, since 1934, district engineer in charge of the Indianapolis office of the association. During the past year Mr. McDargh has been president of the Indianapolis Construction League.



H. J. McDargh

He was formerly with the Bridge Department of the city of Chicago, Engineering Department of the Illinois Central Railroad, and the Indiana State Highway Commission. He is an alumnus of Rose Polytechnic Institute.

▼

"Caterpillar" Forms Central Sales Division

Caterpillar Tractor Co., Peoria, Ill., announces the appointment of Louis B. Neumiller as sales manager of its Central Sales Division. Edw. W. Jackson has been promoted to the office of general service manager, the position held by Mr. Neumiller prior to his advancement.

The Central Sales Division is a sales area created by the division of the United States into three sales areas instead of the former two. It includes roughly the territory lying between the Rocky Mountains and the Mississippi River.

H. M. Hale is sales manager of the Eastern Sales Division, H. H. Chambers of the Western Sales Division, and F. G. Nunnelly of Canada. All of these men make their headquarters at Peoria excepting Mr. Chambers, who headquarters at San Leandro, Calif.

The realignment of sales areas has been prompted by the increase in the number of products manufactured and by the constantly increasing diversification of markets. It will serve to facilitate better administration and will benefit present and prospective "Caterpillar" customers.

▼

Nine Companies Join Asphalt Institute

Nine asphalt producing companies were elected to membership in the Asphalt Institute at a recent board of directors' meeting held in New Orleans, it has been announced by J. E. Pennybacker, Managing Director of the Institute. The new members bring the total of companies substituting Asphalt Institute membership up to 35. Following is a list of the new members:

Anderson-Prichard Oil Corp., Oklahoma City, Okla.

Col-Tex. Refining Co., Oklahoma City, Okla.

Cosco Oil Co., Fort Worth, Tex.

Cosden Oil Corp., Fort Worth, Tex.

Magnolia Petroleum Co., Dallas, Tex.

Exeter Refining Co., Long Beach, Calif.

M. M. McCallen Refining & Producing Co., Huntington Beach, Calif.

The Petrol Corp., Los Angeles, Calif.

San Fernando Refining Co., San Fernando, Calif.

The 28 board members who attended the meeting decided to establish a branch office of the Institute at Dallas, Tex. The board also voted to hold a National Asphalt Conference this year, the time and place to be announced later.

The annual meeting formerly has been known as the Asphalt Paving Conference but because of the importance of new uses for asphalt developed within recent years, it was voted to broaden the scope of the forthcoming conference. In addition to serving as a clearing house for ideas on the building of more and better roads for less money, this year's Asphalt Conference will deal with asphalt in relation to flood control and the protection of harbors through asphalt jetties similar to the ones recently built at Galveston and Astoria, Oregon.

Asphalt revetments have been successfully used to protect the banks of the lower Mississippi and one of the main purposes of this year's Asphalt Conference will be to gear the asphalt industry into an efficient public service relationship with the nation's entire flood control program.

▼

H. S. Watson Co. Moves to Larger Quarters

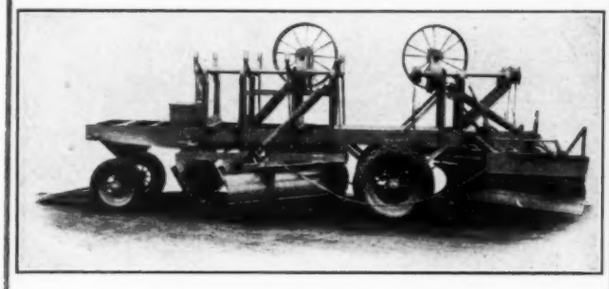
Removal of H. S. Watson Co. to enlarged quarters at 1145 Harrison St., San Francisco, is announced by H. S. Watson. The concern is the national distributor for numerous Brown-Lipe and Spicer automotive products and Watson-Brown-Lipe auxiliary transmissions. Other products include needle-bearing flexible couplings and Trustop brakes. The firm's new home occupies four times the space of its previous location and includes warehouse facilities for thousands of units. During the past year Watson service distributors have been appointed in approximately 60 cities throughout the country. An eastern branch was also opened in Toledo.

▼

New Representative for Toncan Iron Drainage Products

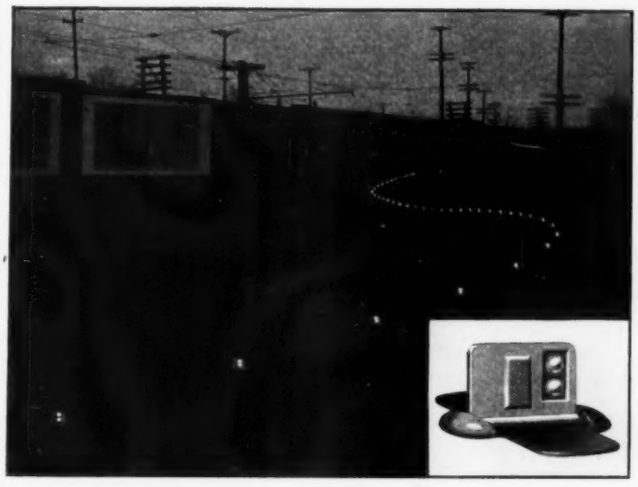
The Toncan Culvert Manufacturers' Association, Republic Bldg., Cleveland, O., announces the formation of a new company which will represent the Toncan iron

THE PARSONS Turbo-Retread



The only machine which mixes, windrows, spreads and edges Road Mix Materials. Used by leading road builders for every kind of binders, road oils, cut-back asphalts, emulsions, calcium and cement stabilization.

THE PARSONS COMPANY
NEWTON, IOWA
In Writing, Mention Roads & Streets



AT night LIFE LINE TRAFFIC MARKERS do extra duty. Headlights pick up the Reflectorized center lines hundreds of yards ahead of the danger point. This high visibility automatically produces more cautious driving where caution and safety are needed.

They are flexible, will not injure a vehicle nor be injured, either by a vehicle or a snow plow. They do not yell but they do a good job of policing traffic. Any driver can see them and he automatically follows them—stays where he belongs—on his own share of the road. They decrease traffic risks, tend to prevent running off the road. Helps bring down the accident toll by pressing home the point that the right side is the safe side.

NATIONAL TRAFFIC APPLIANCE CO.
3088 West 106th Street, Cleveland, Ohio

CENTER CONTROL *means Full Control!*

ask a user

Users of WARCO Center Control Graders in construction work are amazed at the vast amount of heavy construction work they will perform. They are more than an ordinary maintainer. The center control feature affording the operator full vision, positive and easy control, permits their use on numerous difficult jobs possible only with center control machines.





WARCO J & S Traction Treads are heavy duty Traction Equipment for single or dual pneumatic tired equipment of all kinds.

Built to withstand severe conditions they are comparable to crawler equipment and will plow their way through snow, ice, mud, and soft ground where otherwise they would sink in or spin.

WARCO Center Control Motor Graders have gained a widespread favorable reputation by their performance and reliability. The new models with new traction developments and many other improvements will even surpass the machines that have established this reputation.

W. A. RIDDELL CORPORATION
Successor to W. A. Riddell Co. — Hadfield-Penfield Steel Co.
American Clay Machinery Co.
BUCYRUS, OHIO
Interested Distributors write Dept. D.

Yes—We would like you to mention ROADS AND STREETS

drainage products in the state of Indiana. The new company will be known as the Indiana Toncan Culvert Co. with offices at 802 Inland Bldg., Indianapolis, Ind. The new company has taken over the business and affairs of the Indiana Culvert Division of the Truscon Steel Co., Indianapolis. W. H. Hampton and D. R. Sanders, long connected in the selling and promotion of Toncan iron drainage products, are the principals of the newly formed company.

▼

Gorman-Rupp Increase Plant Capacity

In order to provide manufacturing facilities to take care of a greatly increased volume of business, Gorman-Rupp Co. of Mansfield, O., pump manufacturers, are completing an addition to their plant which will provide them with a 50 per cent increase in capacity.

▼

NEW LITERATURE

Asphalt Roads—Intermediate Types—A booklet designed to furnish the road and street official and the contractor with helpful information on the various low-cost types of Texaco asphalt surfacing, has been published by The Texas Co., 135 East 42nd St., New York. With the aid of appropriate photographic illustrations the booklet discusses road-mix construction with Texaco surfacing material, plant-mix construction with Texaco surfacing material, surface treatment with both Texaco surfacing material and Texaco asphalt cement and dust laying with Texaco surfacing material. A group of tables which the road official and contractor will find useful is included. Write The Texas Co. for your copy.

Equipment Lubrication—The Alemite Division of Stewart-Warner Corporation, Chicago, has just published its 1937 industrial catalog—"Alemite Controlled Lubrication." The introduction calls it the "Show Book of the Alemite Systems," and in 56 pages are presented the entire range of Alemite's industrial equipment—hand guns, power-operated units, fittings, hose, valves, meters, etc., including a complete section of hand gun repair parts, simplifying the ordering of parts for standard Alemite equipment. The book is printed in two colors, and is profusely illustrated with photographs, drawings and diagrams. An interesting feature is the great number of photographs of Alemite equipment in actual use in many different types of industries—photographs taken on an extensive trip sponsored last year by Alemite to secure a collection of such photographs with data on how modern systematic lubrication is cutting maintenance costs in industry. For a free copy of "Alemite Controlled Lubrication," send your request to Stewart-Warner Corporation, 1826 Diversey Parkway, Chicago, Ill.

Road Building Equipment—The complete line of road building equipment of the Barber-Greene Co., Aurora, Ill., is shown in a 52 page booklet just issued by the company. It contains descriptions and illustrations (many of them job pictures) of the B-G bituminous travel plant (heavy duty and county models), the B-G central plant and the B-G bituminous finisher. Bucket loaders, including loader applications, belt conveyors and applications are illustrated and described as well as the B-G vertical boom ditcher and the B-G snow loader. A copy of the catalog will be sent to anyone writing the company.

Soil Stabilization—A new bulletin on "Low Cost Roads Stabilized With Aggregates, Binder Soil and Calcium Chloride" has just been issued by the Calcium Chloride Association, covering specifications, design of mixtures, construction, and maintenance. Profusely illustrated with pictures and charts, this new bulletin tells, in 85 pages, the story of soil-stabilization. In addition to the data on procedure, the manual contains a bibliography of outstanding articles and reports on the subject and a glossary of terms most commonly used. Bulletin No. 25 may be obtained, gratis, upon request addressed to the Calcium Chloride Association, 4145 Penobscot Building, Detroit, Michigan.

Electric Arc Welding—An attractive new catalog on the new 40 volt simplified electric arc welding has been gotten out by Hobart Brothers. It contains many illustrations of the various jobs this new welding can handle, as well as the complete description of the line, specifications, etc. It will be sent upon request to any of our readers who will write Hobart Brothers Co., Box FR-173, Troy, O.

Tarmac for Roal Construction and Maintenance—A 70-page handbook containing complete tables and useful general information relative to the use of Tarmac for road construction and maintenance, has just been issued for free distribution by Koppers Company's Tar and Chemical Division. The book also contains a discussion of methods and advantages of soil stabilization with Tarmac, condensed specifications for various methods of using road tars, and tables of data not previously issued in handbook form. There also is a list of other Koppers products for the highway and public works field such as crack filler, paving pitch, traffic marking paint, dampproofing and waterproofing materials, old style pitch and approved felt for roofing, kolineum, Grade 1 creosote, koleener, weed killers, disinfectants, municipal incinerators, Fast's couplings, fire hydrants, water works gate valves, dam gates, treated timber, American hammered piston rings, gas holders and welded and riveted pipe. General offices of the Tar and Chemical Division of Koppers Company are located in Pittsburgh, with district offices in Woodward, Ala., Chicago, Ill., Kearney, N. J., and Providence, R. I. Address Tar and Chemical Division Koppers Co., Koppers Bldg., Pittsburgh, Pa., for your copy of the handbook.

Speed Patrols—A new catalog has just been issued giving information on the complete line of Allis-Chalmers Speed Patrols. Action pictures show the machines working under many different operating conditions. Features of the patrols are described and illustrated with photographs in an interesting manner. Several pages are devoted to the tandem drive models brought out early in 1936. Details of the Controlled Ignition Diesel fuel engine are given in the new catalog. This type of engine has been used for several years in Allis-Chalmers tractors and has gained widespread acclaim from road machinery users. A copy of the new Speed Patrol catalog can be secured by writing Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis.

Bituminous Distributors—A 24 page catalog has been issued by E. D. Etnyre & Co., illustrating and describing their Models FC and FX bituminous distributors. The various features of this equipment are described in detail, of particular interest being the descriptions and illustrations of the new Etnyre pump, the new Etnyre circulating system and the instantaneous shut-off spray bar. The publication is interesting and useful. Write E. D. Etnyre & Co., Oregon, Ill., for your copy of Catalog 506-A.

Reinforcing Metal, Joints, etc.—Truscon's complete line of products for the reinforcement and protection of concrete road construction is illustrated and described in a new catalog just issued by the Truscon Steel Co., Youngstown, O. Details of air cushion expansion joint, contraction plate and guard rail are given with their specifications. Other products illustrated and described include road forms, steel fabric, curb and edge protectors. A copy can be obtained by writing to the company.



Get MODERN HIGHWAY SAFETY *with* MULTISAFTY





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